TECHNICAL GUIDANCE DOCUMENT

INDIANA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

Ex-Situ Treatment of Dense Non-Aqueous Phase Liquids Using Calcium Oxide (Quick Lime)

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Mitchell E. Daniels, Jr. **Governor** *Thomas W. Easterly* **Commissioner**

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Guidance Created: February 10, 2009 Revised: November 17, 2009

Notice

The Technology Evaluation Work Group completed this evaluation of Ex-Situ Treatment of Dense Non-Aqueous Phase Liquids Using Calcium Oxide (Quick Lime) based on professional expertise and review of items listed in the "References" section of this document. The criteria for performing the evaluation are generally described in the IDEM OLQ technical memorandum, *Submittal Guidance for Evaluation of Innovative Remediation Technologies*.

This evaluation does not approve this technology nor does it verify its effectiveness in conditions not identified here. Mention of trade names or commercial products does not constitute endorsement or recommendation by the IDEM for use.

Background

Calcium Oxide (CaO, Quick Lime) is a white crystalline solid manufactured by heating limestone, dolomite, coral, oyster shells, or chalk (which are all mainly calcium carbonate, $CaCO_3$) to drive off carbon dioxide. Quick Lime is used in the construction industry for soil drying, modification, and stabilization. Quick Lime reacts with water to produce heat according to the following reaction:

$$CaO + H_2O \rightarrow Ca(OH)_2 + Heat$$

When applied to wet soils, the reaction consumes approximately 30% water by weight and provides dry solids for stability.

The case-study provided for review (Dean, 2003) discussed the use of Quick Lime for the ex-situ treatment of Dense, Non-Aqueous Phase Liquids (DNAPLs) – specifically TCE and 1,1,1 TCA – in soils at a site in Florida. The original plan for the site called for ex-situ vacuum extraction of all contaminated soils. Quick Lime was added to the soils at an approximate 5% ratio to improve the soil handling characteristics during removal. Project managers observed that the mixing with Quick Lime caused a reaction which

reduced contaminants to below the leachability soil cleanup target levels. Approximately 11,500 cubic yards of soil were eventually treated with Quick Lime and returned to the excavation after verification sample results showed treatment goals had been met.

One conclusion of the case-study is that Quick Lime may likewise be used effectively for treatment of DNAPLs in soils at other similar sites. After reviewing the case-study and consulting additional sources (listed in references section), the following summary comments were compiled.

Advantages

From an environmental standpoint, Quick Lime is benign. Quick Lime is frequently used in water treatment operations and in agriculture when pH control is needed.

Cost: For the Florida case-study provided, an estimated savings of $2.5 - $3 million was realized when compared to off-site transport and disposal. Quick Lime is not a specialty chemical, and is readily available and relatively easy to obtain and manage in bulk.

A study in the United Kingdom (Schifano, 2006) showed that "significant decreases in concentrations of petroleum hydrocarbon compounds were measured in soils and leachates upon quick lime mixing."

Physical properties of the soils are favorably changed by Quick Lime treatment in many cases. Lime reacts with medium, moderately fine and fine-grained soils to produce decreased plasticity, increased workability, reduced swelling, and increased strength.

The addition of Quick Lime may be used to adjust the pH of soils to a level where metals contaminants are least likely to leach. However, the long-term stability of this method and the effects of pH change by Quick Lime on the leachability of some metals are currently not well understood.

Limitations

Field demonstrations have not successfully identified the dominant mechanism responsible for the reduction in DNAPL concentrations in Quick Lime treated soils. Possible reactions include:

- Volatilization of the DNAPLs as a result of the increased temperature occurring during Quick Lime addition.
- Enhanced abiotic destruction of the chemicals resulting from an increase in temperature.
- Entrapment of the contaminants in the soil – $Ca(OH)_2$ matrix.

Likewise, a United Kingdom study (Schifano, 2006) concluded:

- The increase in temperature due to the exothermic hydration reaction of quicklime when in contact with porewater helps to volatilize the light compounds

but may not be entirely responsible for their concentration decreases and for the decrease of heavy aliphatics and aromatics concentrations.

Other unknowns are the resulting byproducts of conversion, their mobility and toxicity, the disposition of the treated soil for disposal, and the impacts of the treatment on the microbial populations present in the soil.

Due to the above unknowns, additional research is needed before Quick Lime treatment can be considered a reliable, cost-effective remediation process for soils.

Problems Encountered

No major problems encountered in references reviewed.

Safety Issues

Quick Lime will react with any moisture, including sweat, eyes and lung tissue, so adequate PPE is essential. Quick Lime is incompatible with many organics, halogens, acids, and combustible materials. Standard safety procedures should be applied.

Indiana Case Studies (or use in similar environment)

Quick Lime has been and is currently being used – either alone or in combination with other treatments – for treatment of DNAPLs and other contaminants in soils at Indiana sites. However, no detailed case studies for Indiana were available at the time this memorandum was prepared. Although the Florida case-study provided appeared to show that Quick Lime was useful for ex-situ treatment of DNAPLs at a particular site, it cannot be concluded that the treatment would work at a similar site in Indiana. The dominant mechanism for the reaction between Quick Lime and the contaminants has not been determined. Since Indiana site conditions may vary considerably from those at the Florida site, the effect of these variations on the treatment process cannot be accurately predicted.

Conclusion

Quick Lime appears to be an effective, low-cost product for ex-situ treatment of DNAPL contamination in soils. However, very few case-studies for this treatment process were available, and no Indiana case-studies were located. Additional research is needed to determine

- The dominant mechanism for contaminant reductions due to the treatment,
- A list of contaminants for which the treatment is effective,
- Necessary site conditions for the treatment to be effective,
- Appropriate and cost-effective mixing procedures and amounts of Quick Lime needed for treatment, and
- Regulatory guidance for post-treatment monitoring.

Until more information on this treatment has been evaluated, Quick Lime must be seen as experimental only.

Further Information

If you have any additional information regarding this technology or any questions about the evaluation, please contact Jim Risch, Environmental Chemist, at (317) 233-6541 or by e-mail at jrisch@idem.in.gov. This technical guidance document will be updated periodically or if new information is acquired.

References

Barnes, Curtis, Project Manager, 2005. "Evaluation of Quicklime Application as a Method of Treating Contaminated Soils," presented at The TRB Committee on Waste Management's Environmental Stewardship in transportation Through Waste Management, Materials Reuse and EMS Conference, July 18, 2005.

Dean, William Gordon, 2003. "Ex-Situ Treatment of Dense Non-Aqueous Phase Liquids Using Calcium Oxide (Quick Lime)," presented at 19th Annual Conference on Soils, Sediments and Water, October 20-23, 2003.

Marion, Giles M., *et al*, 1997. "Site Remediation via Dispersion by Chemical Reaction (DCR)," U.S. Army Corps of Engineers, Cold Regions Research & Engineering Laboratory, Special Report 97-18.

Medina, Victor F., *et al*, 2007. "Evaluation of Lime and Persulfate treatment of Mixed Contaminant Soil from Plum Brook Ordnance Works (Sandusky, Ohio)," U.S. Army Corps of Engineers, Engineer Research and Development Center, Environmental Laboratory, September 2007.

Office of Geotechnical Engineering, 2008. "Design Procedures for Soil Modification or Stabilization," Indiana Department of Transportation, January 2008, available at: http://www.in.gov/indot/files/smod.pdf.

Robinson, David and Angyal, Gary, 2008. "Use of Mixed Technologies to Remediate Chlorinated DNAPL at a Brownfields Site," *Remediation Journal*, 18(3), 41-53. [Abstract Only]

Schifano, V., *et al*, 2006. "Evaluation of Quicklime Mixing for the Remediation of Petroleum Contaminated Soils," *Journal of Hazardous Materials*, 141(2): 395-409. [Abstract Only]

Williams, Susan, 2005. "The Uses of Lime in Site Preparation," *Utility Contractor*, July/Aug 2005, 22-23.

FIELD DEMONSTRATION REPORT

FOR THE

TREATMENT OF TCE IMPACTED SOILS
IN THE VADOSE AND PERCHED GROUNDWATER ZONES
AT THE FORMER IMPEX FACILITY
905 LOUISE STREET
CRAWFORDSVILLE, INDIANA 47933
IDEM VRP SITE NO. 6010902

PREPARED FOR

IMPEX REALTY HOLDING, INC.
5430 LBJ FREEWAY
DALLAS, TEXAS 75240

PREPARED BY

ENTACT SERVICES LLC
3129 BASS PRO DRIVE
GRAPEVINE, TEXAS 76051

MAY 23, 2008

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ENTACT performed a field demonstration on TCE-impacted soils in the vadose and perched groundwater zones at the Former Impex Facility to assess the effectiveness of using calcium oxide treatment to reduce TCE concentrations in the impacted upper silty clay present at the site. This field demonstration was conducted from March 6-28, 2008, pursuant to the requirements of the approved Field Demonstration Workplan dated December 5, 2007. The following paragraphs further describe the sequence and components of the field demonstration.

1.0 Mobilization

ENTACT mobilized the required personnel and equipment, e.g., hydraulic excavator with bucket and hammer attachments, a man-lift, water truck, and a box fan, to the site on March 6, 2008. Calcium oxide in the 3/8 inch minus pebble lime form was delivered to the site in 1-ton super sacks and was staged adjacent to the demonstration area on concrete.

2.0 Site Preparation

The field demonstration began at soil boring QB-88, where the highest TCE concentrations were expected at a depth of 0-2 feet below ground surface (bgs). This soil boring was located in the field based on the information provided in the site investigation reports and marked with spray paint. A 25 foot by 25 foot area centered on this soil boring was also marked with spray paint to indicate the extent of the demonstration area.

A 3.5 foot by 8 foot section of the composite wood roof above the center of the proposed excavation was cut using a sawzall, removed and lowered to the floor. A box fan was then installed in the space to facilitate ventilation during the field demonstration. The concrete slab in the 25 foot by 25 foot demonstration area was broken apart using a hydraulic excavator equipped with a concrete hammer. The broken concrete was removed and placed in a stockpile adjacent to the demonstration area under roof.

Background air monitoring was initiated on March 7, 2008, during the site preparation activities, at the site perimeter and near the proposed work zone. Summa canisters were placed on elevated surfaces at the site perimeter on the exterior of the east and west sides of the building. The personal dataRAMs (pDR) were placed inside and outside of the building with one pDR inside the north end of the building and one pDR outside the east side of the building. The personal air monitors were also placed inside and outside of the building with one personal air monitor in the field demonstration area and one personal air monitor outside the east side of the building. The exterior air monitoring locations were consistent with the predominant wind directions identified during the field demonstration. The summa canister samples and personal air monitoring samples were submitted to TestAmerica Laboratories, Inc. in Austin, Texas and TestAmerica Laboratories, Inc. in Phoenix, Arizona, respectively, for analysis of TCE, cis-1,2-DCE and vinyl chloride.

On March 7, 2008, a pre-treatment sample was collected from the exposed soils at soil boring QB-88 from a depth of 0 to 2 feet and submitted to TestAmerica Laboratories, Inc. in Corpus Christi, Texas for analysis of TCE, cis-1,2-DCE and vinyl chloride.

3.0 Excavation, Treatment and Sampling

On March 10, 2008, while awaiting the laboratory results for the pre-treatment sample, the exposed soils were stabilized with 1 ton of calcium oxide. The perched groundwater encountered in the excavation was used to augment the thermal reaction. Additional water was added as needed during treatment and for dust suppression purposes. The expected reaction typical of the mixture of calcium oxide and soil pore space water did not occur. It was later determined that the calcium oxide received at the site was not of appropriate quality. The results of the pre-treatment sample also indicated that TCE concentrations in the 0-2 foot soil horizon were less than indicated from the previous investigation. Since the calcium oxide that was used to stabilize the material did not meet the specifications, a post-treatment sample was not collected.

Based on the fact that the expected concentrations of TCE were not encountered in the soils underneath the building, e.g. 4,900 ug/kg TCE was detected where the previous investigation detected 530,000 ug/kg, ENTACT moved the field demonstration to an area located outside of the building on the west side where recent elevated TCE concentrations, 266,000 ug/kg, were known to exist at a depth of 18-20 feet below ground surface (Grid AB-23). On March 13, 2008, a 20 foot by 20 foot area in Grid AB-23 was excavated to a depth of 18 feet below ground surface. The overburden material was removed from the excavation and placed adjacent to the hole.

A pre-treatment sample was then collected from the exposed soils at a depth of approximately 18 feet below ground surface and submitted to Pace Analytical in Indianapolis, Indiana for analysis of TCE, cis-1,2-DCE and vinyl chloride. Shortly after sample collection, the 18 to 20 foot horizon was stabilized with approximately 5% calcium oxide by weight. The calcium oxide was thoroughly mixed with the soil using the bucket of a hydraulic excavator. The perched groundwater encountered in the excavation was used to augment the thermal reaction. Additional water was added as needed during treatment and for dust suppression purposes. After a period of 24 hours, on March 14, 2008, a post-treatment sample was collected from the stabilized soil and submitted to Pace Analytical for analysis of TCE, cis-1,2-DCE and vinyl chloride. The stabilized soils were then excavated and transferred to the building interior for temporary stockpiling on visqueen sheeting. An additional post-treatment sample was collected from the interior soil stockpile on March 28, 2008, after allowing additional time for cooling of the soils.

The interior stockpile was sampled on April 18, 2008 to further evaluate remedial progress in the the exterior former storage yard area. The samples were submitted for analysis of pH and TCE, cis-1,2-DCE and vinyl chloride using the synthetic precipitation leaching procedure (SPLP).

Air samples were also collected during the treatment effort on March 11 and 12, 2008 at the locations previously presented. All soil samples taken during the field demonstration were collected as grab samples using U.S. EPA Method 5035 and the Encore sampling device. Refer to Figure 1 for a depiction of the field demonstration locations.

4.0 Restoration

The initial treatment and excavation area located inside the building was backfilled with the stabilized soils and graded. The exterior excavation was backfilled with the overburden material initially removed from the excavation and any extra space was filled with locally imported stone material. The backfill soil/stone was placed in the excavation in horizontal lifts not exceeding 18 to 24 inches in thickness. Each lift was placed in the excavation, graded and compacted by mechanical means.

The section of the roof that was removed for the field demonstration was repaired at the completion of the field demonstration. Plywood wrapped in visqueen sheeting was used to patch the roof opening.

The work area was cleaned and all personnel, equipment and supplies were demobilized from the site on March 17, 2008.

5.0 Results and Discussion

5.1 Air Monitoring

Air monitoring was conducted during the field demonstration to determine background concentrations at and near the site and to determine if the potential exists for the treatment activities to impact workers and the surrounding community through fugitive dust emissions. Background samples were collected prior to the start of the treatment activities. These results showed non-detectable concentrations of TCE, cis-1,2-DCE and vinyl chloride for both the personal air monitoring samples and the perimeter summa canisters. Samples collected during the treatment activities showed non-detectable concentrations and minor detections for both the personal air monitoring samples and the perimeter summa canisters. The detectable results were compared to the OSHA permissible exposure levels (PEL) for each constituent of concern. The comparison showed that the detectable air monitoring results were well below the OSHA PELs for each constituent of concern. Therefore, the treatment of the TCE impacted soils at this site will not pose a risk to human health or the environment or the on-site workers or local residences.

The air monitoring results are included on Tables 1 and 2 and the locations of the air monitoring devices are depicted on Figure 1. Copies of the laboratory analytical reports are included in Attachment 1.

5.2 Soil Samples

Pre-treatment soil samples were collected from the identified locations to determine the TCE concentration in the impacted soil prior to treatment. The results of the pre-treatment soil samples from areas QB-88 and AB-23 indicated lower concentrations of TCE than were previously detected. Post-treatment soil samples were collected from the treated soil to show the effect of treatment with calcium oxide on the TCE concentrations in the impacted soil. The post-treatment sample results showed a significant decrease in the TCE concentration in the treated soils, an approximate 87% to 99% decrease. The results, therefore, indicate that the calcium

oxide treatment methodology produces acceptable results for the reuse of the treated soils as backfill at the site.

The March 28, 2008 post-treatment sample results also showed that the treatment methodology is more effective when the treated soils have cooled and the reaction has been completed. In an effort to shorten the curing time and allow the soils to cool completely prior to sampling, ENTACT proposes to spread the stockpile of treated soils after 24 hours to a uniform thickness. This will allow the treated soils to cool completely and achieve a • 10% moisture content before the material is sampled.

The April 18, 2008 post-treatment sample results show that the treated soil reached a pH of 7.9 within a 3 week period after treatment. We believe that the final pH will not have an adverse effect on the biological treatment activities currently being implemented at the downgradient enhanced reductive dechlorination (ERD) barrier system (presently operating in the deeper sand and gravel aquifer underlying the site). The SPLP results indicate that TCE was detected in the leachate at concentrations below the default soil migration to groundwater closure level and the groundwater default closure level for industrial sites. In addition, the movement of any potential TCE present in future leachate will be further attenuated by the compaction of the treated soils in the backfilled excavation.

The pre-treatment and post-treatment soil sample results are included on Table 3. Copies of the laboratory analytical reports are included in Attachment 1.

6.0 Conclusions

Based on the results of the field demonstration activities, we believe that the calcium oxide treatment methodology will be successful in treating the TCE-impacted soils in the vadose and shallow perched groundwater zones to concentrations that will allow the reuse of the soils as backfill at the site.

TABLE 1: PERSONAL AIR MONITOR LABORATORY ANALYTICAL RESULTS
FORMER IMPEX FACILITY, CRAWFORDSVILLE, INDIANA

Sample ID No.	Sample Date	Lab Report No.	cis-1,2-DCE (ppm)	TCE (ppm)	Vinyl Chloride (ppm)
OSHA PEL			**200**	**100**	**1**
ENTACT Action Levels			**100**	**50**	**0.5**
AS-FD-P01 front	03/07/08	PRC1068	<0.503	<0.439	<0.391
AS-FD-P02 front	03/07/08	PRC1068	<0.503	<0.439	<0.391
AS-FD-PFB1	03/07/08	PRC1068	<9.98*	<11.8*	<5*
AS-FD-P01 back	03/07/08	PRC1068	NA	NA	<0.391
AS-FD-P02 back	03/07/08	PRC1068	NA	NA	<0.391
AS-FD-P03 front	03/11/08	PRC1068	5.15	0.841	<0.391
AS-FD-P03 back	03/11/08	PRC1068	NA	NA	<0.391
AS-FD-P04 front	03/11/08	PRC1068	<0.503	<0.439	<0.391
AS-FD-P04 back	03/11/08	PRC1068	NA	NA	<0.391
AS-FD-PFB2	03/11/08	PRC1068	<9.98*	<11.8*	<5*
AS-FD-P05 front	03/12/08	PRC1068	<0.503	<0.439	<0.391
AS-FD-P05 back	03/12/08	PRC1068	NA	NA	<0.391
AS-FD-P06 front	03/12/08	PRC1068	<0.503	<0.439	<0.391
AS-FD-P06 back	03/12/08	PRC1068	NA	NA	<0.391
AS-FD-PFB3	03/12/08	PRC1068	<9.98*	<11.8*	<5*

*Total concentration in ug not considering flow rates, etc. for field blank purposes

TABLE 2: SUMMA CANISTER LABORATORY ANALYTICAL RESULTS
FORMER IMPEX FACILITY, CRAWFORDSVILLE, INDIANA

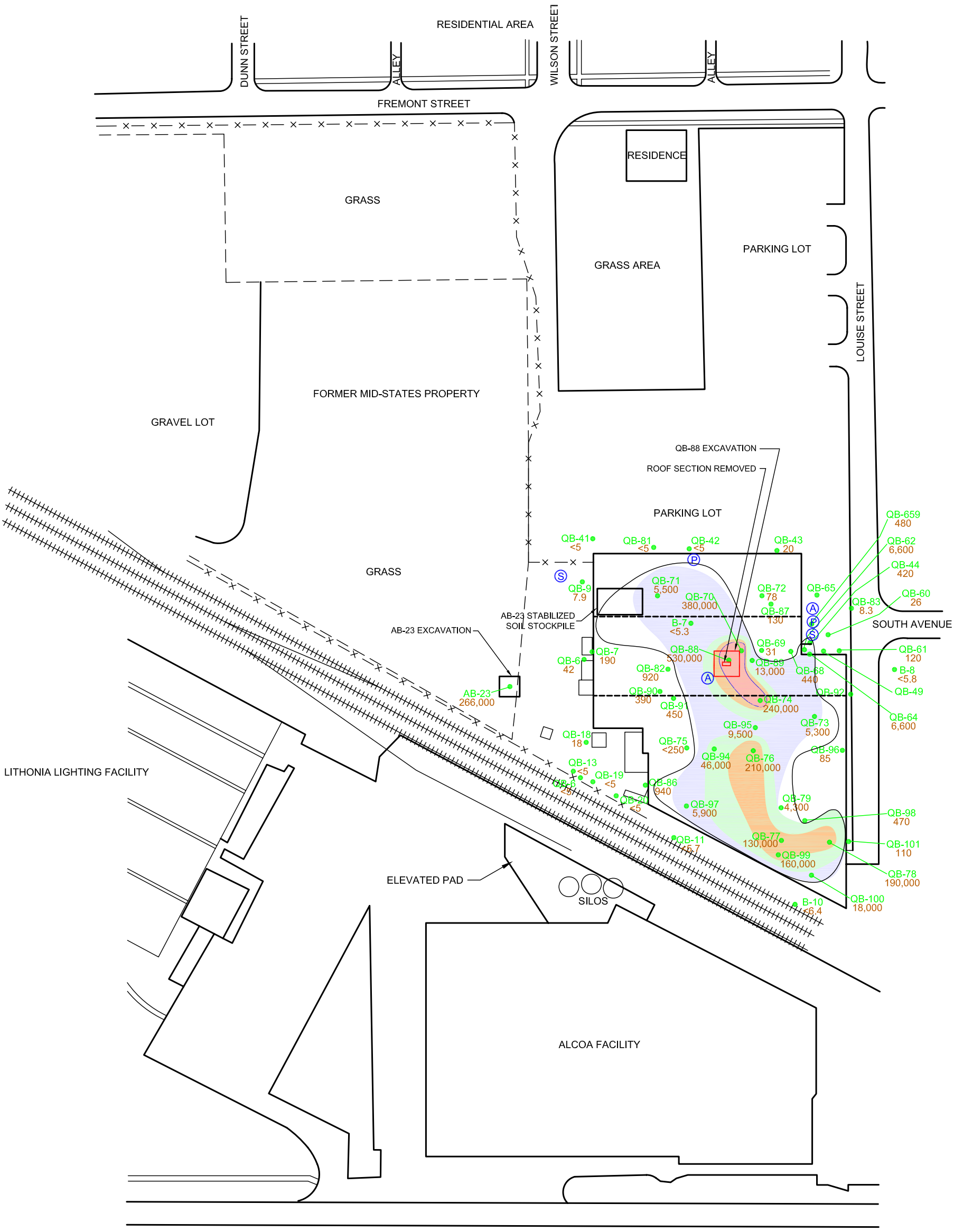
Sample ID No.	Sample Date	Lab Report No.	cis-1,2-DCE		TCE		Vinyl Chloride	
PELs (ug/m3)			793050		537000		2570	
Molecular Weight			96.94		131.4		62.5	
Analytical Results*			**ppbv**	**ug/m3**	**ppbv**	**ug/m3**	**ppbv**	**ug/m3**
TO-FD-01E	03/07/08	20803040	<0.103	0.408377	<0.130	0.69865	<0.112	0.286298569
TO-FD-01W	03/07/08	20803040	<0.121	0.479744	<0.154	0.827632	<0.133	0.33997955
TO-FD-02E	03/11/08	20803040	0.189	0.749352	0.696	3.740466	<0.136	0.347648262
TO-FD-02W	03/11/08	20803040	<0.153	0.606618	<0.194	1.042601	<0.167	0.426891616
TO-FD-03E	03/12/08	20803040	<0.125	0.495603	0.269	1.445669	<0.137	0.350204499
TO-FD-03W	03/12/08	20803040	0.13	0.515427	0.559	3.004196	<0.134	0.342535787

* Analytical results were reported in ppbv by the laboratory and converted to ug/m^3 by ENTACT

TABLE 3: SOIL LABORATORY ANALYTICAL RESULTS
FORMER IMPEX FACILITY, CRAWFORDSVILLE, INDIANA

Sample ID No.	Sample Location	Sample Date	Sample Depth (ft)	Lab Report No.	Total (ug/kg)			SPLP (ug/l)			pH
					cis-1,2-DCE	TCE	Vinyl Chloride	cis-1,2-DCE	TCE	Vinyl Chloride	
FD-S88-Pre	Soil boring QB-88	03/07/08	0-2	560-9081-1	400	4900	<490				
FD-AB23-Pre	Soil boring AB-23	03/13/08	18-19	5012923	6880	48600	297				
AB-23 Post[1]	Treated soil stockpile	03/14/08	NA	5012998	629	6340	<5.1				
AB-23-Post-2[2]	Treated soil stockpile	03/28/08	NA	5013472	<6.3	70	<6.3				
Comp-8	Treated soil stockpile	04/18/08	NA	5014193				<5	22.8	<2	7.9

[1] Post-treatment sample collected after 24 hours
[2] Post-treatment sample collected after 2 weeks



LEGEND

RAILROAD TRACKS		1,000 ug/kg	
FORMER MID-STATES WIRE PROPERTY		4,900 ug/kg	
FENCE LINE		25,730 ug/kg (EXCEEDS VRP TIER II NON-RESIDENTIAL)	
SOIL BORING		100,000 ug/kg	
<5	TCE CONCENTRATION (ug/kg)	200,000 ug/kg	
Ⓢ	SUMMA CANISTER		
Ⓟ	PORTABLE DATA RAM		
Ⓐ	PERSONAL AIR MONITOR		

N

0 25 50 100

SCALE IN FEET

FIELD DEMONSTRATION LOCATIONS

FORMER IMPEX FACILITY
CRAWFORDSVILLE, IN

FIGURE 1

NO.	DATE	REVISION	APP.

Scale: 1"=100' | Drawn By: DM | Checked By: JE | Date: 9/2006

ENTACT
environmental services
3129 Bass Pro Drive · Grapevine, TX 76051
(972) 580-1323 · Fax (972) 550-7464

P:\Projects\Contran - Crawfordsville\Drawings\crawfordsville-004.dwg, ENTACT

ATTACHMENT 1

LABORATORY ANALYTICAL REPORTS

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

4645 East Cotton Center Blvd. Building 3, Ste 189 Phoenix, AZ 85040 * (602) 437-3340 * Fax (602) 454-9303

March 27, 2008

LABORATORY REPORT

Client:
ENTACT Environmental Services
3129 Bass Pro Dr.
Grapevine, TX 76051
Attn: Aaron McCorvey

Work Order:	PRC1068
Project Name:	Crawfordville, IN
Project Number:	Impex Crawfordsville/D1712
Date Received:	03/13/08

The results listed within this Laboratory Report pertain only to the samples tested in the laboratory. The analyses contained in this report were performed in accordance with the applicable certifications as noted. All soil samples are reported on a wet weight basis unless otherwise noted in the report. This Laboratory Report is confidential and is intended for the sole use of TestAmerica and its client. This report shall not be reproduced, except in full, without written permission from TestAmerica.

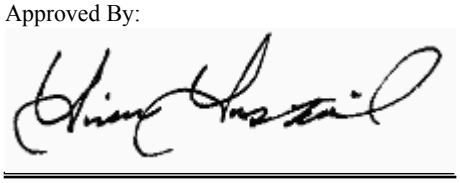
TestAmerica Analytical Testing Corporation certifies that the analytical results contained herein apply only to the specific sample(s) analyzed.

The Chain(s) of Custody, 2 pages, are included and are an integral part of this report. This entire report was reviewed and approved for release.

If you have any questions relating to this analytical report, please contact your Laboratory Project Manager at 1-(602)437-3340

Analyses included in this report were performed by the laboratory shown at the top of this report unless otherwise indicated.

Approved By:



Tim Trestrail
Project Manager

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING
4645 East Cotton Center Blvd. Building 3, Ste 189 Phoenix, AZ 85040 * (602) 437-3340 * Fax (602) 454-9303

ENTACT Environmental Services
3129 Bass Pro Dr.
Grapevine, TX 76051
Aaron McCorvey

Work Order: PRC1068
Project: Crawfordville, IN
Project Number: Impex Crawfordsville/D1712

Received: 03/13/08
Reported: 03/27/08 14:03

SAMPLE IDENTIFICATION	LAB NUMBER	COLLECTION DATE	CONTAINER TYPE
AS-FD-P01 front	PRC1068-01	03/07/08	50/100 mg - Coconut Shell Charcoal Tube
AS-FD-P02 front	PRC1068-02	03/07/08	50/100 mg - Coconut Shell Charcoal Tube
AS-FD-PFB1	PRC1068-03	03/07/08	50/100 mg - Coconut Shell Charcoal Tube
AS-FD-P01 back	PRC1068-04	03/07/08	50/100 mg - Coconut Shell Charcoal Tube
AS-FD-P02 back	PRC1068-05	03/07/08	50/100 mg - Coconut Shell Charcoal Tube
AS-FD-P03 front	PRC1068-06	03/11/08	50/100 mg - Coconut Shell Charcoal Tube
AS-FD-P03 back	PRC1068-07	03/11/08	50/100 mg - Coconut Shell Charcoal Tube
AS-FD-P04 front	PRC1068-08	03/11/08	50/100 mg - Coconut Shell Charcoal Tube
AS-FD-P04 back	PRC1068-09	03/11/08	50/100 mg - Coconut Shell Charcoal Tube
AS-FD-PFB2	PRC1068-10	03/11/08	50/100 mg - Coconut Shell Charcoal Tube
AS-FD-P05 front	PRC1068-11	03/12/08	50/100 mg - Coconut Shell Charcoal Tube
AS-FD-P05 back	PRC1068-12	03/12/08	50/100 mg - Coconut Shell Charcoal Tube
AS-FD-P06 front	PRC1068-13	03/12/08	50/100 mg - Coconut Shell Charcoal Tube
AS-FD-P06 back	PRC1068-14	03/12/08	50/100 mg - Coconut Shell Charcoal Tube
AS-FD-PFB3	PRC1068-15	03/12/08	50/100 mg - Coconut Shell Charcoal Tube

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING
4645 East Cotton Center Blvd. Building 3, Ste 189 Phoenix, AZ 85040 * (602) 437-3340 * Fax (602) 454-9303

ENTACT Environmental Services
3129 Bass Pro Dr.
Grapevine, TX 76051
Aaron McCorvey

Work Order: PRC1068
Project: Crawfordville, IN
Project Number: Impex Crawfordsville/D1712

Received: 03/13/08
Reported: 03/27/08 14:03

ANALYTICAL REPORT

Analyte	Result			Qual	Date Analyzed	Analyst	Rpt Limit	Method
Halogenated Hydrocarbons by NIOSH 1003/OSHA 7 (Modified)								
Sample ID: PRC1068-01 (AS-FD-P01 front)	**Tube**		**Sample Air Volume:5L**				**Sampled: 03/07/08**	
	ug, Total	mg/m3	ppm				ug, Total	
cis-1,2-Dichloroethylene	<9.98	<2	<0.503		3/19/2008	ZN	9.98	NIOSH 1003
Trichloroethylene	<11.8	<2.36	<0.439		3/19/2008	ZN	11.8	NIOSH 1003
Sample ID: PRC1068-02 (AS-FD-P02 front)	**Tube**		**Sample Air Volume:5L**				**Sampled: 03/07/08**	
	ug, Total	mg/m3	ppm				ug, Total	
cis-1,2-Dichloroethylene	<9.98	<2	<0.503		3/19/2008	ZN	9.98	NIOSH 1003
Trichloroethylene	<11.8	<2.36	<0.439		3/19/2008	ZN	11.8	NIOSH 1003
Sample ID: PRC1068-03 (AS-FD-PFB1)	**Tube**		**Sample Air Volume:L**				**Sampled: 03/07/08**	
	ug, Total	mg/m3	ppm				ug, Total	
cis-1,2-Dichloroethylene	<9.98				3/19/2008	ZN	9.98	NIOSH 1003
Trichloroethylene	<11.8				3/19/2008	ZN	11.8	NIOSH 1003
Sample ID: PRC1068-06 (AS-FD-P03 front)	**Tube**		**Sample Air Volume:5L**				**Sampled: 03/11/08**	
	ug, Total	mg/m3	ppm				ug, Total	
cis-1,2-Dichloroethylene	102	20.4	5.15		3/19/2008	ZN	9.98	NIOSH 1003
Trichloroethylene	22.6	4.52	0.841		3/19/2008	ZN	11.8	NIOSH 1003
Sample ID: PRC1068-08 (AS-FD-P04 front)	**Tube**		**Sample Air Volume:5L**				**Sampled: 03/11/08**	
	ug, Total	mg/m3	ppm				ug, Total	
cis-1,2-Dichloroethylene	<9.98	<2	<0.503		3/19/2008	ZN	9.98	NIOSH 1003
Trichloroethylene	<11.8	<2.36	<0.439		3/19/2008	ZN	11.8	NIOSH 1003
Sample ID: PRC1068-10 (AS-FD-PFB2)	**Tube**		**Sample Air Volume:L**				**Sampled: 03/11/08**	
	ug, Total	mg/m3	ppm				ug, Total	
cis-1,2-Dichloroethylene	<9.98				3/19/2008	ZN	9.98	NIOSH 1003
Trichloroethylene	<11.8				3/19/2008	ZN	11.8	NIOSH 1003
Sample ID: PRC1068-11 (AS-FD-P05 front)	**Tube**		**Sample Air Volume:5L**				**Sampled: 03/12/08**	
	ug, Total	mg/m3	ppm				ug, Total	
cis-1,2-Dichloroethylene	<9.98	<2	<0.503		3/19/2008	ZN	9.98	NIOSH 1003
Trichloroethylene	<11.8	<2.36	<0.439		3/19/2008	ZN	11.8	NIOSH 1003
Sample ID: PRC1068-13 (AS-FD-P06 front)	**Tube**		**Sample Air Volume:5L**				**Sampled: 03/12/08**	
	ug, Total	mg/m3	ppm				ug, Total	
cis-1,2-Dichloroethylene	<9.98	<2	<0.503		3/19/2008	ZN	9.98	NIOSH 1003
Trichloroethylene	<11.8	<2.36	<0.439		3/19/2008	ZN	11.8	NIOSH 1003
Sample ID: PRC1068-15 (AS-FD-PFB3)	**Tube**		**Sample Air Volume:L**				**Sampled: 03/12/08**	
	ug, Total	mg/m3	ppm				ug, Total	
cis-1,2-Dichloroethylene	<9.98				3/19/2008	ZN	9.98	NIOSH 1003
Trichloroethylene	<11.8				3/19/2008	ZN	11.8	NIOSH 1003
Vinyl Chloride by NIOSH 1007 (Modified)								
Sample ID: PRC1068-01 (AS-FD-P01 front)	**Tube**		**Sample Air Volume:5L**				**Sampled: 03/07/08**	

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ENTACT Environmental Services
3129 Bass Pro Dr.
Grapevine, TX 76051
Aaron McCorvey

Work Order: PRC1068
Project: Crawfordville, IN
Project Number: Impex Crawfordsville/D1712

Received: 03/13/08
Reported: 03/27/08 14:03

Analyte	Result			Qual	Date Analyzed	Analyst	Rpt Limit	Method
Vinyl Chloride by NIOSH 1007 (Modified) - cont.								
Sample ID: PRC1068-01 (AS-FD-P01 front) - cont.	**Tube**		**Sample Air Volume:5L**					**Sampled: 03/07/08**
	ug, Total	mg/m3	ppm				ug, Total	
Vinyl chloride	<5.00	<1	<0.391		3/19/2008	ZN	5.00	N1007(MOD)
Sample ID: PRC1068-02 (AS-FD-P02 front)	**Tube**		**Sample Air Volume:5L**					**Sampled: 03/07/08**
	ug, Total	mg/m3	ppm				ug, Total	
Vinyl chloride	<5.00	<1	<0.391		3/19/2008	ZN	5.00	N1007(MOD)
Sample ID: PRC1068-03 (AS-FD-PFB1)	**Tube**		**Sample Air Volume:L**					**Sampled: 03/07/08**
	ug, Total	mg/m3	ppm				ug, Total	
Vinyl chloride	<5.00				3/19/2008	ZN	5.00	N1007(MOD)
Sample ID: PRC1068-04 (AS-FD-P01 back)	**Tube**		**Sample Air Volume:5L**					**Sampled: 03/07/08**
	ug, Total	mg/m3	ppm				ug, Total	
Vinyl chloride	<5.00	<1	<0.391		3/19/2008	ZN	5.00	N1007(MOD)
Sample ID: PRC1068-05 (AS-FD-P02 back)	**Tube**		**Sample Air Volume:5L**					**Sampled: 03/07/08**
	ug, Total	mg/m3	ppm				ug, Total	
Vinyl chloride	<5.00	<1	<0.391		3/19/2008	ZN	5.00	N1007(MOD)
Sample ID: PRC1068-06 (AS-FD-P03 front)	**Tube**		**Sample Air Volume:5L**					**Sampled: 03/11/08**
	ug, Total	mg/m3	ppm				ug, Total	
Vinyl chloride	<5.00	<1	<0.391		3/19/2008	ZN	5.00	N1007(MOD)
Sample ID: PRC1068-07 (AS-FD-P03 back)	**Tube**		**Sample Air Volume:5L**					**Sampled: 03/11/08**
	ug, Total	mg/m3	ppm				ug, Total	
Vinyl chloride	<5.00	<1	<0.391		3/19/2008	ZN	5.00	N1007(MOD)
Sample ID: PRC1068-08 (AS-FD-P04 front)	**Tube**		**Sample Air Volume:5L**					**Sampled: 03/11/08**
	ug, Total	mg/m3	ppm				ug, Total	
Vinyl chloride	<5.00	<1	<0.391		3/19/2008	ZN	5.00	N1007(MOD)
Sample ID: PRC1068-09 (AS-FD-P04 back)	**Tube**		**Sample Air Volume:5L**					**Sampled: 03/11/08**
	ug, Total	mg/m3	ppm				ug, Total	
Vinyl chloride	<5.00	<1	<0.391		3/19/2008	ZN	5.00	N1007(MOD)
Sample ID: PRC1068-10 (AS-FD-PFB2)	**Tube**		**Sample Air Volume:L**					**Sampled: 03/11/08**
	ug, Total	mg/m3	ppm				ug, Total	
Vinyl chloride	<5.00				3/19/2008	ZN	5.00	N1007(MOD)
Sample ID: PRC1068-11 (AS-FD-P05 front)	**Tube**		**Sample Air Volume:5L**					**Sampled: 03/12/08**
	ug, Total	mg/m3	ppm				ug, Total	
Vinyl chloride	<5.00	<1	<0.391		3/19/2008	ZN	5.00	N1007(MOD)
Sample ID: PRC1068-12 (AS-FD-P05 back)	**Tube**		**Sample Air Volume:5L**					**Sampled: 03/12/08**
	ug, Total	mg/m3	ppm				ug, Total	
Vinyl chloride	<5.00	<1	<0.391		3/19/2008	ZN	5.00	N1007(MOD)
Sample ID: PRC1068-13 (AS-FD-P06 front)	**Tube**		**Sample Air Volume:5L**					**Sampled: 03/12/08**
	ug, Total	mg/m3	ppm				ug, Total	
Vinyl chloride	<5.00	<1	<0.391		3/19/2008	ZN	5.00	N1007(MOD)
Sample ID: PRC1068-14 (AS-FD-P06 back)	**Tube**		**Sample Air Volume:5L**					**Sampled: 03/12/08**

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ENTACT Environmental Services
3129 Bass Pro Dr.
Grapevine, TX 76051
Aaron McCorvey

Work Order: PRC1068
Project: Crawfordville, IN
Project Number: Impex Crawfordsville/D1712

Received: 03/13/08
Reported: 03/27/08 14:03

Analyte	Result			Qual	Date Analyzed	Analyst	Rpt Limit	Method
Vinyl Chloride by NIOSH 1007 (Modified) - cont.								
Sample ID: PRC1068-14 (AS-FD-P06 back) - cont.	**Tube**			**Sample Air Volume:5L**				**Sampled: 03/12/08**
	ug, Total	mg/m3	ppm				ug, Total	
Vinyl chloride	<5.00	<1	<0.391		3/19/2008	ZN	5.00	N1007(MOD)
Sample ID: PRC1068-15 (AS-FD-PFB3)	**Tube**			**Sample Air Volume:L**				**Sampled: 03/12/08**
	ug, Total	mg/m3	ppm				ug, Total	
Vinyl chloride	<5.00				3/19/2008	ZN	5.00	N1007(MOD)

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Grapevine, TX 76051
Aaron McCorvey

Work Order: PRC1068
Project: Crawfordville, IN
Project Number: Impex Crawfordsville/D1712

Received: 03/13/08
Reported: 03/27/08 14:03

PROJECT QUALITY CONTROL DATA

Blank

Analyte	Blank Value	Q	Units	Q.C. Batch	Lab Number	Analyzed Date
Vinyl Chloride by NIOSH 1007 (Modified)						
P8C1822-BLK1						
Vinyl chloride	<2.50		ug, Total	P8C1822	P8C1822-BLK1	03-18-2008
Vinyl chloride - Back	<2.50		ug, Total	P8C1822	P8C1822-BLK1	03-18-2008
Halogenated Hydrocarbons by NIOSH 1003/OSHA 7 (Modified)						
P8C1821-BLK1						
cis-1,2-Dichloroethylene - Back	<4.99		ug, Total	P8C1821	P8C1821-BLK1	03-18-2008
Trichloroethylene	<5.91		ug, Total	P8C1821	P8C1821-BLK1	03-18-2008
Trichloroethylene - Back	<5.91		ug, Total	P8C1821	P8C1821-BLK1	03-18-2008
cis-1,2-Dichloroethylene	<4.99		ug, Total	P8C1821	P8C1821-BLK1	03-18-2008

LCS

Analyte	Known Val.	Analyzed Val	Q	Units	% Rec.	Target Range	Batch	Analyzed Date
Vinyl Chloride by NIOSH 1007 (Modified)								
P8C1822-BS1								
Vinyl chloride	5.2	4.735		ug, Total	91%	75-125	P8C1822	03-18-2008
Halogenated Hydrocarbons by NIOSH 1003/OSHA 7 (Modified)								
P8C1821-BS1								
Trichloroethylene	14.7	15.10		ug, Total	103%	75-125	P8C1821	03-18-2008
cis-1,2-Dichloroethylene	12.9	12.58		ug, Total	98%	75-125	P8C1821	03-18-2008

LCS Dup

Analyte	Orig. Val.	Duplicate	Q	Units	Spike Conc	% Rec.	Target Range	RPD	Limit	Batch	Sample Duplicated	Analyzed Date
Vinyl Chloride by NIOSH 1007 (Modified)												
P8C1822-BSD1												
Vinyl chloride		4.733		ug, Total	5.2	91%	75-125	0.0423	30	P8C1822		03-18-2008
Halogenated Hydrocarbons by NIOSH 1003/OSHA 7 (Modified)												
P8C1821-BSD1												
Trichloroethylene		15.00		ug, Total	14.7	102%	75-125	0.664	30	P8C1821		03-18-2008
cis-1,2-Dichloroethylene		12.86		ug, Total	12.9	100%	75-125	2.2	30	P8C1821		03-18-2008

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ENTACT Environmental Services	Work Order:	PRC1068	Received: 03/13/08
3129 Bass Pro Dr.			Reported: 03/27/08 14:03
Grapevine, TX 76051	Project:	Crawfordville, IN	
Aaron McCorvey	Project Number:	Impex Crawfordsville/D1712	

CERTIFICATION SUMMARY

Analyses included in this report were performed by TestAmerica Laboratories, Inc. (TAL), 4645 E. Cotton Center Boulevard, Building 3, Suite 189, Phoenix, AZ 85040.

TAL Phoenix (Lab ID 154268) is accredited by the American Industrial Hygiene Association (AIHA) in the industrial hygiene program for the analytical techniques noted on the scope of accreditation for the following methods: NIOSH 0500, NIOSH 0600, NIOSH 1003, NIOSH 1005, NIOSH 1007, NIOSH 1010, NIOSH 1015, NIOSH 1022, NIOSH 1300, NIOSH 1400, NIOSH 1401, NIOSH 1403, NIOSH 1405, NIOSH 1450, NIOSH 1457, NIOSH 1500, NIOSH 1501, NIOSH 1550, NIOSH 1602, NIOSH 1604, NIOSH 1606, NIOSH 1609, NIOSH 1611, NIOSH, 1613, NIOSH 1615, NIOSH 2000, NIOSH 2532, NIOSH 2546, NIOSH 2551, NIOSH 5000, NIOSH 5503, NIOSH 5506, NIOSH 5600, NIOSH 6001, NIOSH 6006, NIOSH 6009, NIOSH 6010, NIOSH 7300, NIOSH 7600, NIOSH 7903, OSHA 7, OSHA 42, OSHA 47, OSHA 48, OSHA 64, OSHA 69, OSHA 111, OSHA ID-140, OSHA ID-121, OSHA 1001, OSHA 1002, OSHA 1003, OSHA 1004, OSHA 1005 and OSHA Chemical and Sampling Information for Silane. Volatile organic compounds on 3M Organic Vapor Monitors, Assay Technology Passive Monitors and SKC Passive Monitors. Formaldehyde and other aldehydes and ketones on Assay Technology Passive Monitor. Aldehydes and ketones by EPA TO-11A.

TAL Phoenix also holds NELAC accreditation through the State of Oregon (AZ100001) for the analytical techniques noted on the scope of accreditation and the State of New York (11898) for NIOSH 6009.

Samples were analyzed using methods outlined in references such as:

-OSHA - Occupational Safety and Health Administration, U. S. Department of Labor, OSHA Analytical Methods Manual.
-NIOSH - National Institute for Occupational Safety and Health, U. S. Department of Health and Human Services, NIOSH Manual of Analytical Methods, Fourth Edition, 1994, and Updates. NIOSH Method 7300 analyses are performed using a modified digestion procedure to eliminate the use of perchloric acid.
-EPA - U. S. Environmental Protection Agency, Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, Second Edition, 1999.
-EPA - U. S. Environmental Protection Agency, Analytical Methods, Emission Measurement Center (EMC).

Analytical Comments:

Unless otherwise noted, all method blanks and laboratory control spikes met method and/or laboratory quality control objectives for the analyses included in this report.

Unless otherwise noted, sample results have been corrected for method blank values.

For information concerning certifications of this facility or another TestAmerica facility, please visit our website at www.TestAmericaInc.com

Aerotech Environmental Laboratories

a division of Aerotech Laboratories, Inc.

[X] Main Lab - 4645 E. Cotton Center Blvd., Building 3, Suite 189, Phoenix, AZ 85040 602.437.3340 - FAX 623.445.6192
[ ] North Phoenix - 1501 W. Knudsen, Phoenix, AZ 85027 623.780.4800 - FAX 623.445.6216
[ ] Tucson - 4455 S. Park Ave, Suite 110, Tucson, AZ 85714 520.807.3801 - FAX 520.807.3803
www.aeroenvirolabs.com or call toll-free 866.772.5227

Lab Number: EM 5113 08-03-0047 08-03-0046 PRC1068

Customer Number:	Page ____ of ____
Name: ENTACT	Sampler: A. McCorvey
Address: 3129 Bass Pro Drive	Project Name: D1712 Impex Crawfordsville
City, State, Zip: Grapevine TX 76051	Project Number:
Contact: Aaron McCorvey	P.O. Number:
Phone: 630-935-9459 Fax:	Fax Results:
E-Mail Address: amccorvey@entact.com	E-Mail Results: (Y) N

Sample Receipt

Temperature _____ °C
Custody Seals: Yes _____ No _____
Custody Seals Intact: Yes _____ No _____
Total # of Containers: _____

Turn Around Request

_____ 24 Hours _____ 48 Hours
_____ 72 Hours
_____ 5 working Day
_____ Standard 10 Working Days
Subject to scheduling and availability (surcharges apply)

Sample Information

Lab #	IH Media Type	Flow Rate	Sample Identification	Date	Start Time	Stop Time	Total Minutes	Total Volume (L)	Number of Media per Sample	Analyses Requested: TCE	cis 1,2-DCE	Vinyl Chloride
11	Coconut tube	0.05L/m	AS-FD-POS front	3-12-08	10:00	11:40	100	5L	1	X	X	X
12	"	↓	AS-FD-POS back	3-12-08	10:00	11:40	100	5	1			X
13	"	↓	AS-FD-P06 front	3-12-08	10:12	11:52	100	5	1	X	X	X
14	"	↓	AS-FD-P06 back	3-12-08	10:12	11:52	100	5	1			X
15	"	0	AS-FD-PFB3	3-12-08	10:00	11:40	100		1	X	X	X

Instructions / Special Requirements:

Date:	Time:	Samples Relinquished By:	Received By:
3-12-08	01:00 PM	Aaron McCorvey	FED EX
3/13/08	10:30	FED EX	

Aerotech Environmental Laboratories

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[ ] Tucson - 4455 S. Park Ave, Suite 110, Tucson, AZ 85714 520.807.3801 - FAX 520.807.3803
www.aeroenvirolabs.com or call toll-free 866.772.5227

Lab Number: 0803-0046

Customer Number:	Page ____ of ____
Name: ENTACT	Sampler: A. MCCOREY
Address: 3129 Bass Pro Drive	Project Name: Impex Crawfordsville
City, State, Zip: Grapevine TX 76051	Project Number: D1712
Contact: Aaron McCorvey	P.O. Number:
Phone: 650-938-9459 Fax:	Fax Results: Y N
E-Mail Address: amccorvey@entact.com	E-Mail Results: (Y) N

Sample Receipt

Temperature 14.7 °C
Custody Seals: Yes____ No____
Custody Seals Intact: Yes____ No____
Total # of Containers:____

Turn Around Request

____ 24 Hours ____ 48 Hours
____ 72 Hours
____ 5 working Day
____ Standard 10 Working Days
Subject to scheduling and availability (surcharges apply)

Analyses Requested

Sample Information

Lab #	II Media Type	Flow Rate	Sample Identification	Date	Start Time	Stop Time	Total Minutes	Total Volume (L)	Number of Media per Sample	TCE	cis 1,2-DCE	Vinyl chloride
1	Coconut tube	0.05 L/min	AS-FD-P01 front	3-7-08	10:30	12:10	100	5	1	X	X	X
2	"	"	AS-FD-P02 front	3-7-08	10:40	12:20	100	5	1	X	X	X
3	"	0	AS-FD-PFB1	3-7-08	10:30	12:10	100		2	X	X	X
4	"	0.05 L/m	AS-FD-P01 back	3-7-08	10:30	12:10	100	5	1			X
5	"	0.05 L/m	AS-FD-P02 back	3-7-08	10:40	12:20	100	5	1			X
6	"	0.05 L/m	AS-FD-P03 front	3-11-08	09:30	11:10	100	5	1	X	X	X
7	"	↓	AS-FD-P03 back	↓	↓	11:10	100	5	1			X
8	"	↓	AS-FD-P04 front			11:10	100	5	1	X	X	X
9	"	↓	AS-FD-P04 back			11:10	100	5	1			X
10	"	0	AS-FD-PFB2			11:10	100		1	X	X	X

Instructions / Special Requirements:

Date:	Time:	Samples Relinquished By:	Received By:
3-12-08	1:00 pm	Aaron McCorvey	FED EX
3/13/08	10:30	FED EX	

All services are performed subject to the Terms & Conditions on the reverse side.

TestAmerica Austin

Laboratory Analysis Report

March 31, 2008

Aaron McCorvey
3129 Bass Pro Drive
Grapevine, TX 76051

630-935-9459 (Business)

RE: Laboratory Reference: Impex Crawfordsville [20803040] ENTACT

Dear Aaron McCorvey:

TestAmerica Austin received samples with a request for the analytical fractions listed below. Except as noted in the QCER(s) all laboratory quality control parameters were met. These data have been reviewed and released by the person below. Results for the indicated analytical fractions and associated quality control data are enclosed in this report.

Fraction	Status	Reported	Approval Signature/Date
VOC	ENCLOSED	03/31/2008	Carla Shelley 3-31-08

The report is provided as indicated in the Table of Contents (Page i) and it is followed by Appendix A which includes any additional information associated with the report. This report must not be reproduced, except in full, without the written approval of the laboratory.

TestAmerica Austin appreciates your business and looks forward to serving you again. If you have any questions about your report or need any additional information, please call me at (512)310-5202 or fax inquiries to (512)244-0160.

Sincerely,

Linda Voigt
Client Services/Project Manager

SECTION I
Table of Contents

SECTION II
Case Narrative

The 1,2-dichloroethane-d4 surrogate failed the acceptance criteria in sample TO-FD-01E with a recovery of 137% (limits 70-130%). The sample was reanalyzed, and the 1,2-dichloroethane-d4 surrogate failed the acceptance criteria again with a recovery of 134%. Both sets of results are reported.

The 1,2-dichloroethane-d4 surrogate failed the acceptance criteria in sample TO-FD-01W with a recovery of 136% (limits 70-130%). The sample was reanalyzed, and the 1,2-dichloroethane-d4 surrogate failed the acceptance criteria again with a recovery of 136%. Both sets of results are reported.

The 1,2-dichloroethane-d4 surrogate failed the acceptance criteria in sample TO-FD-02E with a recovery of 136% (limits 70-130%). The sample was reanalyzed, and the 1,2-dichloroethane-d4 surrogate failed the acceptance criteria again with a recovery of 134%. Both sets of results are reported.

The 1,2-dichloroethane-d4 surrogate failed the acceptance criteria in sample TO-FD-02W with a recovery of 137% (limits 70-130%). The sample was reanalyzed, and the 1,2-dichloroethane-d4 surrogate failed the acceptance criteria again with a recovery of 136%. Both sets of results are reported.

The 1,2-dichloroethane-d4 surrogate failed the acceptance criteria in sample TO-FD-03E with a recovery of 136% (limits 70-130%). The sample was reanalyzed, and the 1,2-dichloroethane-d4 surrogate failed the acceptance criteria again with a recovery of 136%. Both sets of results are reported.

The 1,2-dichloroethane-d4 surrogate failed the acceptance criteria in sample TO-FD-03W with a recovery of 134% (limits 70-130%). The sample was reanalyzed, and the 1,2-dichloroethane-d4 surrogate failed the acceptance criteria again with a recovery of 134%. Both sets of results are reported.

SECTION III
Report Summaries

VOC

Client Name: ENTACT
Client Code: ENTACT

Project Name: Impex Crawfordsville [20803040] ENTACT
Facility Name:

Workorder Summary

Client Sample ID	Lab Sample ID	Sample Matrix	Method Citation	Method Description
TO-FD-01E	2080304001	Air	TO15 Ambient	VOC Ambient GC/MS
TO-FD-01W	2080304002	Air	TO15 Ambient	VOC Ambient GC/MS
TO-FD-02E	2080304003	Air	TO15 Ambient	VOC Ambient GC/MS
TO-FD-02W	2080304004	Air	TO15 Ambient	VOC Ambient GC/MS
TO-FD-03E	2080304005	Air	TO15 Ambient	VOC Ambient GC/MS
TO-FD-03W	2080304006	Air	TO15 Ambient	VOC Ambient GC/MS

Protocol Summary

Client Sample ID	Lab Sample ID	Date & Time Collected	Date & Time Received	Prep Batch ID	Date & Time Prepared	Analysis Batch ID	Date & Time Analyzed	Hold Time Spec			
								Prep		Analysis	
								Spec	Actual	Spec	Actual
Method: TO15 Ambient											
TO-FD-01E	2080304001	03/07/08 10:30	03/17/08 08:00	54694	03/20/08 21:31	54694	03/20/08 21:31	30D	13D	30D	13D
TO-FD-01E	2080304001	03/07/08 10:30	03/17/08 08:00	54798	03/25/08 21:39	54798	03/25/08 21:39	30D	18D	30D	18D
TO-FD-01W	2080304002	03/07/08 10:30	03/17/08 08:00	54694	03/20/08 22:35	54694	03/20/08 22:35	30D	13D	30D	13D
TO-FD-01W	2080304002	03/07/08 10:30	03/17/08 08:00	54798	03/25/08 22:45	54798	03/25/08 22:45	30D	18D	30D	18D
TO-FD-02E	2080304003	03/11/08 09:00	03/17/08 08:00	54694	03/20/08 23:39	54694	03/20/08 23:39	30D	9D	30D	9D
TO-FD-02E	2080304003	03/11/08 09:00	03/17/08 08:00	54798	03/25/08 23:51	54798	03/25/08 23:51	30D	14D	30D	14D
TO-FD-02W	2080304004	03/11/08 09:00	03/17/08 08:00	54694	03/21/08 00:43	54694	03/21/08 00:43	30D	10D	30D	10D
TO-FD-02W	2080304004	03/11/08 09:00	03/17/08 08:00	54798	03/26/08 00:57	54798	03/26/08 00:57	30D	15D	30D	15D

VOC

Protocol Summary continued -

Client Sample ID	Lab Sample ID	Date & Time Collected	Date & Time Received	Prep Batch ID	Date & Time Prepared	Analysis Batch ID	Date & Time Analyzed	Hold Time Spec			
								Prep		Analysis	
								Spec	Actual	Spec	Actual
Method: TO15 Ambient continued -											
TO-FD-03E	2080304005	03/12/08 09:00	03/17/08 08:00	54694	03/21/08 01:47	54694	03/21/08 01:47	30D	9D	30D	9D
TO-FD-03E	2080304005	03/12/08 09:00	03/17/08 08:00	54798	03/26/08 02:02	54798	03/26/08 02:02	30D	14D	30D	14D
TO-FD-03W	2080304006	03/12/08 09:00	03/17/08 08:00	54694	03/21/08 02:52	54694	03/21/08 02:52	30D	9D	30D	9D
TO-FD-03W	2080304006	03/12/08 09:00	03/17/08 08:00	54798	03/26/08 03:08	54798	03/26/08 03:08	30D	14D	30D	14D

SECTION IV
Comments and Flag Definitions

VOC

Standard Data Qualifiers

Flag	Definition
J	Result > or = MDL and <PQL
NA	Not analyzed/Not available
ND	Not detected at the specified reporting limit
Q	Result does not meet specification
U	Result less than sample specific method detection limit

Analyst Comments

Flag	Affected Sample	Method	Comment

Sample Condition Comments

Affected Sample	Comment

SECTION V
Analytical Results

VOC
TO15 Ambient

Client Sample ID	TO-FD-01E	TO-FD-01E	TO-FD-01W
Lab Sample ID	2080304001	2080304001	2080304002
Matrix	Air	Air	Air
Reported As	RECEIVED	RECEIVED	RECEIVED
% Moisture	NA	NA	NA
Date/Time Collected	03/07/2008 10:30	03/07/2008 10:30	03/07/2008 10:30
Date/Time Prepared	03/20/2008 21:31	03/25/2008 21:39	03/20/2008 22:35
Date/Time Analyzed	03/20/2008 21:31	03/25/2008 21:39	03/20/2008 22:35
Dilution Factor	2.5220	2.5220	2.9812
Instrument	GCMSP1	GCMSP1	GCMSP1
Units	ppbV	ppbV	ppbV

Parameter	CAS	Conc	Flag	DL	PQL	Conc	Flag	DL	PQL	Conc	Flag	DL	PQL
cis-1,2-Dichloroethene	156-59-2	ND		0.103	0.504	ND		0.103	0.504	ND		0.121	0.596
Trichloroethene	79-01-6	ND		0.130	0.504	ND		0.130	0.504	ND		0.154	0.596
Vinyl chloride	75-01-4	ND		0.112	0.504	ND		0.112	0.504	ND		0.133	0.596

SECTION V
Analytical Results
Surrogates

VOC
TO15 Ambient

Client Sample ID	TO-FD-01E	TO-FD-01E	TO-FD-01W
Lab Sample ID	2080304001	2080304001	2080304002
Matrix	Air	Air	Air
Reported As	RECEIVED	RECEIVED	RECEIVED
% Moisture	NA	NA	NA
Date/Time Collected	03/07/2008 10:30	03/07/2008 10:30	03/07/2008 10:30
Date/Time Prepared	03/20/2008 21:31	03/25/2008 21:39	03/20/2008 22:35
Date/Time Analyzed	03/20/2008 21:31	03/25/2008 21:39	03/20/2008 22:35
Dilution Factor	2.5220	2.5220	2.9812
Instrument	GCMSP1	GCMSP1	GCMSP1
Units	ppbV	ppbV	ppbV

Surrogate Compound	% Recovery	Limits	F	% Recovery	Limits	F	% Recovery	Limits	F
1-Bromo-4-fluorobenzene	80	70-130		80	70-130		82	70-130	
1,2-Dichloroethane-d4	137	70-130	Q	134	70-130	Q	136	70-130	Q
Toluene-d8	98	70-130		99	70-130		98	70-130	

SECTION V
Analytical Results

VOC
TO15 Ambient

Client Sample ID	TO-FD-01W	TO-FD-02E	TO-FD-02E
Lab Sample ID	2080304002	2080304003	2080304003
Matrix	Air	Air	Air
Reported As	RECEIVED	RECEIVED	RECEIVED
% Moisture	NA	NA	NA
Date/Time Collected	03/07/2008 10:30	03/11/2008 09:00	03/11/2008 09:00
Date/Time Prepared	03/25/2008 22:45	03/20/2008 23:39	03/25/2008 23:51
Date/Time Analyzed	03/25/2008 22:45	03/20/2008 23:39	03/25/2008 23:51
Dilution Factor	2.9812	3.0533	3.0533
Instrument	GCMSP1	GCMSP1	GCMSP1
Units	ppbV	ppbV	ppbV

Parameter	CAS	Conc	Flag	DL	PQL	Conc	Flag	DL	PQL	Conc	Flag	DL	PQL
cis-1,2-Dichloroethene	156-59-2	ND		0.121	0.596	0.189	J	0.124	0.611	0.190	J	0.124	0.611
Trichloroethene	79-01-6	ND		0.154	0.596	0.696		0.158	0.611	0.720		0.158	0.611
Vinyl chloride	75-01-4	ND		0.133	0.596	ND		0.136	0.611	ND		0.136	0.611

SECTION V
Analytical Results
Surrogates

VOC
TO15 Ambient

Client Sample ID	TO-FD-01W	TO-FD-02E	TO-FD-02E
Lab Sample ID	2080304002	2080304003	2080304003
Matrix	Air	Air	Air
Reported As	RECEIVED	RECEIVED	RECEIVED
% Moisture	NA	NA	NA
Date/Time Collected	03/07/2008 10:30	03/11/2008 09:00	03/11/2008 09:00
Date/Time Prepared	03/25/2008 22:45	03/20/2008 23:39	03/25/2008 23:51
Date/Time Analyzed	03/25/2008 22:45	03/20/2008 23:39	03/25/2008 23:51
Dilution Factor	2.9812	3.0533	3.0533
Instrument	GCMSP1	GCMSP1	GCMSP1
Units	ppbV	ppbV	ppbV

Surrogate Compound	% Recovery	Limits	F	% Recovery	Limits	F	% Recovery	Limits	F
1-Bromo-4-fluorobenzene	78	70-130		81	70-130		79	70-130	
1,2-Dichloroethane-d4	136	70-130	Q	136	70-130	Q	134	70-130	Q
Toluene-d8	98	70-130		98	70-130		99	70-130	

SECTION V
Analytical Results

VOC
TO15 Ambient

Client Sample ID	TO-FD-02W	TO-FD-02W	TO-FD-03E
Lab Sample ID	2080304004	2080304004	2080304005
Matrix	Air	Air	Air
Reported As	RECEIVED	RECEIVED	RECEIVED
% Moisture	NA	NA	NA
Date/Time Collected	03/11/2008 09:00	03/11/2008 09:00	03/12/2008 09:00
Date/Time Prepared	03/21/2008 00:43	03/26/2008 00:57	03/21/2008 01:47
Date/Time Analyzed	03/21/2008 00:43	03/26/2008 00:57	03/21/2008 01:47
Dilution Factor	3.7585	3.7585	3.0781
Instrument	GCMSP1	GCMSP1	GCMSP1
Units	ppbV	ppbV	ppbV

Parameter	CAS	Conc	Flag	DL	PQL	Conc	Flag	DL	PQL	Conc	Flag	DL	PQL
cis-1,2-Dichloroethene	156-59-2	ND		0.153	0.752	ND		0.153	0.752	ND		0.125	0.616
Trichloroethene	79-01-6	ND		0.194	0.752	ND		0.194	0.752	0.269	J	0.159	0.616
Vinyl chloride	75-01-4	ND		0.167	0.752	ND		0.167	0.752	ND		0.137	0.616

SECTION V
Analytical Results
Surrogates

VOC
TO15 Ambient

Client Sample ID	TO-FD-02W	TO-FD-02W	TO-FD-03E
Lab Sample ID	2080304004	2080304004	2080304005
Matrix	Air	Air	Air
Reported As	RECEIVED	RECEIVED	RECEIVED
% Moisture	NA	NA	NA
Date/Time Collected	03/11/2008 09:00	03/11/2008 09:00	03/12/2008 09:00
Date/Time Prepared	03/21/2008 00:43	03/26/2008 00:57	03/21/2008 01:47
Date/Time Analyzed	03/21/2008 00:43	03/26/2008 00:57	03/21/2008 01:47
Dilution Factor	3.7585	3.7585	3.0781
Instrument	GCMSP1	GCMSP1	GCMSP1
Units	ppbV	ppbV	ppbV

Surrogate Compound	% Recovery	Limits	F	% Recovery	Limits	F	% Recovery	Limits	F
1-Bromo-4-fluorobenzene	81	70-130		79	70-130		81	70-130	
1,2-Dichloroethane-d4	137	70-130	Q	136	70-130	Q	136	70-130	Q
Toluene-d8	99	70-130		98	70-130		97	70-130	

SECTION V
Analytical Results

VOC
TO15 Ambient

Client Sample ID	TO-FD-03E	TO-FD-03W	TO-FD-03W
Lab Sample ID	2080304005	2080304006	2080304006
Matrix	Air	Air	Air
Reported As	RECEIVED	RECEIVED	RECEIVED
% Moisture	NA	NA	NA
Date/Time Collected	03/12/2008 09:00	03/12/2008 09:00	03/12/2008 09:00
Date/Time Prepared	03/26/2008 02:02	03/21/2008 02:52	03/26/2008 03:08
Date/Time Analyzed	03/26/2008 02:02	03/21/2008 02:52	03/26/2008 03:08
Dilution Factor	3.0781	3.0048	3.0048
Instrument	GCMSP1	GCMSP1	GCMSP1
Units	ppbV	ppbV	ppbV

Parameter	CAS	Conc	Flag	DL	PQL	Conc	Flag	DL	PQL	Conc	Flag	DL	PQL
cis-1,2-Dichloroethene	156-59-2	ND		0.125	0.616	0.130	J	0.122	0.601	0.155	J	0.122	0.601
Trichloroethene	79-01-6	0.213	J	0.159	0.616	0.559	J	0.155	0.601	0.639		0.155	0.601
Vinyl chloride	75-01-4	ND		0.137	0.616	ND		0.134	0.601	ND		0.134	0.601

SECTION V
Analytical Results
Surrogates

VOC
TO15 Ambient

Client Sample ID	TO-FD-03E	TO-FD-03W	TO-FD-03W
Lab Sample ID	2080304005	2080304006	2080304006
Matrix	Air	Air	Air
Reported As	RECEIVED	RECEIVED	RECEIVED
% Moisture	NA	NA	NA
Date/Time Collected	03/12/2008 09:00	03/12/2008 09:00	03/12/2008 09:00
Date/Time Prepared	03/26/2008 02:02	03/21/2008 02:52	03/26/2008 03:08
Date/Time Analyzed	03/26/2008 02:02	03/21/2008 02:52	03/26/2008 03:08
Dilution Factor	3.0781	3.0048	3.0048
Instrument	GCMSP1	GCMSP1	GCMSP1
Units	ppbV	ppbV	ppbV

Surrogate Compound	% Recovery	Limits	F	% Recovery	Limits	F	% Recovery	Limits	F
1-Bromo-4-fluorobenzene	78	70-130		82	70-130		79	70-130	
1,2-Dichloroethane-d4	136	70-130	Q	134	70-130	Q	134	70-130	Q
Toluene-d8	100	70-130		98	70-130		100	70-130	

SECTION VI
Calibration and QC Information
Calibration Verification Results

VOC
TO15 Ambient

Sample Type: Continuing Calibration Check
Analysis Batch ID: 54694 **Instrument Data File:** PA032005.D **Date/Time Analyzed:** 03/20/2008 13:06
Instrument ID: GCMSP1 **Analyst:** EDN **Units:** ppbV

Parameter	Reference Value	Measured Conc	Flag	%Recovery	Flag	QC Limits %Recovery
cis-1,2-Dichloroethene	11	13.0		118		70-130
Trichloroethene	10.8	11.4		106		70-130
Vinyl chloride	10.5	12.6		120		70-130

SECTION VI
Calibration and QC Information
Calibration Verification Results

VOC
TO15 Ambient

Sample Type: Continuing Calibration Check
Analysis Batch ID: 54798 **Instrument Data File:** PA032502.D **Date/Time Analyzed:** 03/25/2008 10:49
Instrument ID: GCMSP1 **Analyst:** EDN **Units:** ppbV

Parameter	Reference Value	Measured Conc	Flag	%Recovery	Flag	QC Limits %Recovery
cis-1,2-Dichloroethene	11	10.4		94		70-130
Trichloroethene	10.8	9.12		85		70-130
Vinyl chloride	10.5	9.14		87		70-130

SECTION VI
Calibration and QC Information
Mass Spectrometer Tune

VOC
TO15 Ambient
BFB

Analysis Batch ID: 54694
Instrument ID: GCMSP1

Instrument Data File: PA032003.D
Injection Time: 03/20/2008 11:02

Date Analyzed: 03/20/2008 11:02
Analyst: EDN

Mass/Energy	Ion Abundance Criteria		% Relative Abundance
	Lower Limit	Upper Limit	
50	8	40	20.4
75	30	66	55.1
95	100	100	100
96	5	9	6.8
173	0	2	.2
174	50	120	92.4
175	4	9	6.8
176	93	101	93.1
177	5	9	6.4

SECTION VI
Calibration and QC Information
Mass Spectrometer Tune

VOC
TO15 Ambient
BFB

Analysis Batch ID: 54798
Instrument ID: GCMSP1

Instrument Data File: PA032502.D
Injection Time: 03/25/2008 10:49

Date Analyzed: 03/25/2008 10:49
Analyst: EDN

Mass/Energy	Ion Abundance Criteria		% Relative Abundance
	Lower Limit	Upper Limit	
50	8	40	20.1
75	30	66	56.3
95	100	100	100
96	5	9	6.4
173	0	2	1.5
174	50	120	94.9
175	4	9	7.2
176	93	101	93.2
177	5	9	6.6

SECTION VI
Calibration and QC Information
Method Blank Results

VOC
TO15 Ambient

Method Blank ID	1071615	1071663	
Sample Type	Method Blank	Method Blank	
Matrix	Air	Air	
Date/Time Prepared	03/20/2008 14:07	03/25/2008 13:57	
Date/Time Analyzed	03/20/2008 14:07	03/25/2008 13:57	
Instrument	GCMSP1	GCMSP1	
Units	ppbV	ppbV	

Parameter	CAS	Conc	Flag	DL	PQL	Conc	Flag	DL	PQL	Conc	Flag	DL	PQL
cis-1,2-Dichloroethene	156-59-2	ND		0.0407	0.200	ND		0.0407	0.200				
Trichloroethene	79-01-6	ND		0.0517	0.200	ND		0.0517	0.200				
Vinyl chloride	75-01-4	ND		0.0445	0.200	ND		0.0445	0.200				

SECTION VI
Calibration and QC Information
Method Blank Results

VOC
TO15 Ambient

Method Blank ID	1071615	1071663	
Sample Type	Method Blank	Method Blank	
Matrix	Air	Air	
Date/Time Prepared	03/20/2008 14:07	03/25/2008 13:57	
Date/Time Analyzed	03/20/2008 14:07	03/25/2008 13:57	
Instrument	GCMSP1	GCMSP1	
Units	ppbV	ppbV	

Surrogate Compound	% Recovery	Limits	F	% Recovery	Limits	F	% Recovery	Limits	F
1-Bromo-4-fluorobenzene	84	70-130		83	70-130				
1,2-Dichloroethane-d4	118	70-130		120	70-130				
Toluene-d8	92	70-130		92	70-130				

SECTION VI
Calibration and QC Information
Control Sample Results

VOC
TO15 Ambient

Client Sample ID: LCS4 for HBN 54694 [VOC/7387]
Prep Batch ID: 54694
Analysis Batch ID: 54694

Instrument ID: GCMSP1
Units: ppbV
Matrix: Air

% Moisture: NA
Analyst: EDN

	Control Sample			Control Sample Duplicate					
	Lab ID: 1071613			Lab ID: 1071614				QC Limits	
	File ID: PA032003.D			File ID: PA032004.D					
Parameter	Spk Amt	Conc	%Rec Flg	Spk Amt	Conc	%Rec Flg	RPD Flg	%Rec	RPD
cis-1,2-Dichloroethene	11.2	12.1	108	11.2	12.3	110	1.8	70-130	25
Trichloroethene	11.3	10.5	93	11.3	10.9	97	4.2	70-130	25
Vinyl chloride	10.8	11.2	104	10.8	11.7	108	3.8	70-130	25

SECTION VI
Calibration and QC Information
Control Sample Results

VOC
TO15 Ambient

	Lab ID: 1071613		Lab ID: 1071614		
Surrogate Compounds	**%Recovery**	**Flags**	**%Recovery**	**Flags**	**QC Recovery Limits**
1-Bromo-4-fluorobenzene	106		106		70-130
1,2-Dichloroethane-d4	112		110		70-130
Toluene-d8	97		96		70-130

SECTION V
Analytical Results

VOC
TO15 Ambient

Client Sample ID	TO-FD-03E	TO-FD-03W	TO-FD-03W
Lab Sample ID	2080304005	2080304006	2080304006
Matrix	Air	Air	Air
Reported As	RECEIVED	RECEIVED	RECEIVED
% Moisture	NA	NA	NA
Date/Time Collected	03/12/2008 09:00	03/12/2008 09:00	03/12/2008 09:00
Date/Time Prepared	03/26/2008 02:02	03/21/2008 02:52	03/26/2008 03:08
Date/Time Analyzed	03/26/2008 02:02	03/21/2008 02:52	03/26/2008 03:08
Dilution Factor	3.0781	3.0048	3.0048
Instrument	GCMSP1	GCMSP1	GCMSP1
Units	ppbV	ppbV	ppbV

Parameter	CAS	Conc	Flag	DL	PQL	Conc	Flag	DL	PQL	Conc	Flag	DL	PQL
cis-1,2-Dichloroethene	156-59-2	ND		0.125	0.616	0.130	J	0.122	0.601	0.155	J	0.122	0.601
Trichloroethene	79-01-6	0.213	J	0.159	0.616	0.559	J	0.155	0.601	0.639		0.155	0.601
Vinyl chloride	75-01-4	ND		0.137	0.616	ND		0.134	0.601	ND		0.134	0.601

SECTION V
Analytical Results
Surrogates

VOC
TO15 Ambient

Client Sample ID	TO-FD-03E	TO-FD-03W	TO-FD-03W
Lab Sample ID	2080304005	2080304006	2080304006
Matrix	Air	Air	Air
Reported As	RECEIVED	RECEIVED	RECEIVED
% Moisture	NA	NA	NA
Date/Time Collected	03/12/2008 09:00	03/12/2008 09:00	03/12/2008 09:00
Date/Time Prepared	03/26/2008 02:02	03/21/2008 02:52	03/26/2008 03:08
Date/Time Analyzed	03/26/2008 02:02	03/21/2008 02:52	03/26/2008 03:08
Dilution Factor	3.0781	3.0048	3.0048
Instrument	GCMSP1	GCMSP1	GCMSP1
Units	ppbV	ppbV	ppbV

Surrogate Compound	% Recovery	Limits	F	% Recovery	Limits	F	% Recovery	Limits	F
1-Bromo-4-fluorobenzene	78	70-130		82	70-130		79	70-130	
1,2-Dichloroethane-d4	136	70-130	Q	134	70-130	Q	134	70-130	Q
Toluene-d8	100	70-130		98	70-130		100	70-130	

SECTION VI
Calibration and QC Information
Calibration Verification Results

VOC
TO15 Ambient

Sample Type: Continuing Calibration Check
Analysis Batch ID: 54694 **Instrument Data File:** PA032005.D **Date/Time Analyzed:** 03/20/2008 13:06
Instrument ID: GCMSP1 **Analyst:** EDN **Units:** ppbV

Parameter	Reference Value	Measured Conc	Flag	%Recovery	Flag	QC Limits %Recovery
cis-1,2-Dichloroethene	11	13.0		118		70-130
Trichloroethene	10.8	11.4		106		70-130
Vinyl chloride	10.5	12.6		120		70-130

SECTION VI
Calibration and QC Information
Calibration Verification Results

VOC
TO15 Ambient

Sample Type: Continuing Calibration Check
Analysis Batch ID: 54798 **Instrument Data File:** PA032502.D **Date/Time Analyzed:** 03/25/2008 10:49
Instrument ID: GCMSP1 **Analyst:** EDN **Units:** ppbV

Parameter	Reference Value	Measured Conc	Flag	%Recovery	Flag	QC Limits %Recovery
cis-1,2-Dichloroethene	11	10.4		94		70-130
Trichloroethene	10.8	9.12		85		70-130
Vinyl chloride	10.5	9.14		87		70-130

SECTION VI
Calibration and QC Information
Mass Spectrometer Tune

VOC
TO15 Ambient
BFB

Analysis Batch ID: 54694
Instrument ID: GCMSP1

Instrument Data File: PA032003.D
Injection Time: 03/20/2008 11:02

Date Analyzed: 03/20/2008 11:02
Analyst: EDN

Mass/Energy	Ion Abundance Criteria		% Relative Abundance
	Lower Limit	Upper Limit	
50	8	40	20.4
75	30	66	55.1
95	100	100	100
96	5	9	6.8
173	0	2	.2
174	50	120	92.4
175	4	9	6.8
176	93	101	93.1
177	5	9	6.4

SECTION VI
Calibration and QC Information
Mass Spectrometer Tune

VOC
TO15 Ambient
BFB

Analysis Batch ID: 54798
Instrument ID: GCMSP1

Instrument Data File: PA032502.D
Injection Time: 03/25/2008 10:49

Date Analyzed: 03/25/2008 10:49
Analyst: EDN

Mass/Energy	Ion Abundance Criteria		% Relative Abundance
	Lower Limit	Upper Limit	
50	8	40	20.1
75	30	66	56.3
95	100	100	100
96	5	9	6.4
173	0	2	1.5
174	50	120	94.9
175	4	9	7.2
176	93	101	93.2
177	5	9	6.6

SECTION VI
Calibration and QC Information
Method Blank Results

VOC
TO15 Ambient

Method Blank ID	1071615	1071663	
Sample Type	Method Blank	Method Blank	
Matrix	Air	Air	
Date/Time Prepared	03/20/2008 14:07	03/25/2008 13:57	
Date/Time Analyzed	03/20/2008 14:07	03/25/2008 13:57	
Instrument	GCMSP1	GCMSP1	
Units	ppbV	ppbV	

Parameter	CAS	Conc	Flag	DL	PQL	Conc	Flag	DL	PQL	Conc	Flag	DL	PQL
cis-1,2-Dichloroethene	156-59-2	ND		0.0407	0.200	ND		0.0407	0.200				
Trichloroethene	79-01-6	ND		0.0517	0.200	ND		0.0517	0.200				
Vinyl chloride	75-01-4	ND		0.0445	0.200	ND		0.0445	0.200				

SECTION VI
Calibration and QC Information
Method Blank Results

VOC
TO15 Ambient

Method Blank ID	1071615	1071663	
Sample Type	Method Blank	Method Blank	
Matrix	Air	Air	
Date/Time Prepared	03/20/2008 14:07	03/25/2008 13:57	
Date/Time Analyzed	03/20/2008 14:07	03/25/2008 13:57	
Instrument	GCMSP1	GCMSP1	
Units	ppbV	ppbV	

Surrogate Compound	% Recovery	Limits	F	% Recovery	Limits	F	% Recovery	Limits	F
1-Bromo-4-fluorobenzene	84	70-130		83	70-130				
1,2-Dichloroethane-d4	118	70-130		120	70-130				
Toluene-d8	92	70-130		92	70-130				

SECTION VI
Calibration and QC Information
Control Sample Results

VOC
TO15 Ambient

Client Sample ID: LCS4 for HBN 54694 [VOC/7387]
Prep Batch ID: 54694
Analysis Batch ID: 54694

Instrument ID: GCMSP1
Units: ppbV
Matrix: Air

% Moisture: NA
Analyst: EDN

	Control Sample			Control Sample Duplicate					
	Lab ID: 1071613			Lab ID: 1071614				QC Limits	
	File ID: PA032003.D			File ID: PA032004.D					
Parameter	Spk Amt	Conc	%Rec Flg	Spk Amt	Conc	%Rec Flg	RPD Flg	%Rec	RPD
cis-1,2-Dichloroethene	11.2	12.1	108	11.2	12.3	110	1.8	70-130	25
Trichloroethene	11.3	10.5	93	11.3	10.9	97	4.2	70-130	25
Vinyl chloride	10.8	11.2	104	10.8	11.7	108	3.8	70-130	25

SECTION VI
Calibration and QC Information
Control Sample Results

VOC
TO15 Ambient

	Lab ID: 1071613		Lab ID: 1071614		
Surrogate Compounds	**%Recovery**	**Flags**	**%Recovery**	**Flags**	**QC Recovery Limits**
1-Bromo-4-fluorobenzene	106		106		70-130
1,2-Dichloroethane-d4	112		110		70-130
Toluene-d8	97		96		70-130

SECTION VI
Calibration and QC Information
Control Sample Results

VOC
TO15 Ambient

Client Sample ID:	LCS6 for HBN 54798 [VOC/7397]	**Instrument ID:**	GCMSP1	**% Moisture:**	NA
Prep Batch ID:	54798	**Units:**	ppbV	**Analyst:**	EDN
Analysis Batch ID:	54798	**Matrix:**	Air		

	Control Sample			Control Sample Duplicate					
	Lab ID: 1071661			**Lab ID:** 1071662				**QC Limits**	
	File ID: PA032503.D			**File ID:** PA032504.D					
Parameter	**Spk Amt**	**Conc**	**%Rec Flg**	**Spk Amt**	**Conc**	**%Rec Flg**	**RPD Flg**	**%Rec**	**RPD**
cis-1,2-Dichloroethene	11.4	11.8	104	11.4	11.5	100	3.9	70-130	25
Trichloroethene	11.5	10.6	92	11.5	10.2	88	4.4	70-130	25
Vinyl chloride	11	11.3	103	11	10.5	96	7	70-130	25

SECTION VI
Calibration and QC Information
Control Sample Results

VOC
TO15 Ambient

	Lab ID: 1071661		Lab ID: 1071662		
Surrogate Compounds	**%Recovery**	**Flags**	**%Recovery**	**Flags**	**QC Recovery Limits**
1-Bromo-4-fluorobenzene	108		118		70-130
1,2-Dichloroethane-d4	116		115		70-130
Toluene-d8	97		96		70-130

SECTION VII
Batch Summaries

Extraction/Digestion Batch Summary
VOC
TO15 Ambient

Extraction Batch ID: 54694 **Start Date/Time:** 03/20/2008 11:02 **Analyst:** EDN
Stop Date/Time: 03/21/2008 05:51

Client Sample ID	Lab Sample ID	Sample Type	Matrix	Sample Size		Preparation Method
				Initial	Final	
INSTRUMENT QC	1000	GC/MS Tune	Air	0.5 L	1 L	TO15 Ambient
LCS4 for HBN 54694 [VOC/7387]	1071613	Lab Control Sample	Air	0.5 L	1 L	TO15 Ambient
LCSD4 for HBN 54694 [VOC/7387]	1071614	Lab Control Sample Duplicate	Air	0.5 L	1 L	TO15 Ambient
INSTRUMENT QC	1493	Continuing Calibration Check	Air	0.5 L	1 L	TO15 Ambient
MB for HBN 54694 [VOC/7387]	1071615	Method Blank	Air	0.5 L	1 L	TO15 Ambient
ZZZZZZZZZZ	2080303401	Field Sample	Air	0.5 L	1 L	TO15 Ambient
ZZZZZZZZZZ	2080303501	Field Sample	Air	0.5 L	1 L	TO15 Ambient
ZZZZZZZZZZ	2080303402	Field Sample	Air	0.5 L	1 L	TO15 Ambient
ZZZZZZZZZZ	2080303502	Field Sample	Air	0.5 L	1 L	TO15 Ambient
ZZZZZZZZZZ	2080303403	Field Sample	Air	0.5 L	1 L	TO15 Ambient
ZZZZZZZZZZ	2080303503	Field Sample	Air	0.5 L	1 L	TO15 Ambient
ZZZZZZZZZZ	1071628	Duplicate Sample	Air	0.5 L	1 L	TO15 Ambient
ZZZZZZZZZZ	1071629	Duplicate Sample	Air	0.5 L	1 L	TO15 Ambient
ZZZZZZZZZZ	2080303404	Field Sample	Air	0.5 L	1 L	TO15 Ambient
ZZZZZZZZZZ	2080303504	Field Sample	Air	0.5 L	1 L	TO15 Ambient
ZZZZZZZZZZ	2080303405	Field Sample	Air	0.5 L	1 L	TO15 Ambient
ZZZZZZZZZZ	2080303505	Field Sample	Air	0.5 L	1 L	TO15 Ambient
TO-FD-01E	2080304001	Field Sample	Air	0.5 L	1 L	TO15 Ambient
TO-FD-01W	2080304002	Field Sample	Air	0.5 L	1 L	TO15 Ambient
TO-FD-02E	2080304003	Field Sample	Air	0.5 L	1 L	TO15 Ambient
TO-FD-02W	2080304004	Field Sample	Air	0.5 L	1 L	TO15 Ambient
TO-FD-03E	2080304005	Field Sample	Air	0.5 L	1 L	TO15 Ambient
TO-FD-03W	2080304006	Field Sample	Air	0.5 L	1 L	TO15 Ambient
ZZZZZZZZZZ	2080303002	Field Sample	Air	0.1 L	1 L	TO15 Ambient
ZZZZZZZZZZ	2080303003	Field Sample	Air	0.1 L	1 L	TO15 Ambient
ZZZZZZZZZZ	1071630	Duplicate Sample	Air	0.1 L	1 L	TO15 Ambient

SECTION VII
Batch Summaries

Extraction/Digestion Batch Summary
VOC
TO15 Ambient

Extraction Batch ID: 54798 **Start Date/Time:** 03/25/2008 10:49 **Analyst:** EDN
Stop Date/Time: 03/26/2008 03:08

Client Sample ID	Lab Sample ID	Sample Type	Matrix	Sample Size		Preparation Method
				Initial	Final	
INSTRUMENT QC	1000	GC/MS Tune	Air	0.5 L	1 L	TO15 Ambient
INSTRUMENT QC	1493	Continuing Calibration Check	Air	0.5 L	1 L	TO15 Ambient
LCS6 for HBN 54798 [VOC/7397]	1071661	Lab Control Sample	Air	0.5 L	1 L	TO15 Ambient
LCSD6 for HBN 54798 [VOC/7397]	1071662	Lab Control Sample Duplicate	Air	0.5 L	1 L	TO15 Ambient
MB for HBN 54798 [VOC/7397]	1071663	Method Blank	Air	0.5 L	1 L	TO15 Ambient
ZZZZZZZZZZ	2080305501	Field Sample	Air	0.5 L	1 L	TO15 Ambient
ZZZZZZZZZZ	2080305502	Field Sample	Air	0.5 L	1 L	TO15 Ambient
ZZZZZZZZZZ	2080305503	Field Sample	Air	0.5 L	1 L	TO15 Ambient
ZZZZZZZZZZ	1071670	Duplicate Sample	Air	0.5 L	1 L	TO15 Ambient
ZZZZZZZZZZ	2080305504	Field Sample	Air	0.5 L	1 L	TO15 Ambient
ZZZZZZZZZZ	2080305505	Field Sample	Air	0.5 L	1 L	TO15 Ambient
TO-FD-01E	2080304001	Field Sample	Air	0.5 L	1 L	TO15 Ambient
TO-FD-01W	2080304002	Field Sample	Air	0.5 L	1 L	TO15 Ambient
TO-FD-02E	2080304003	Field Sample	Air	0.5 L	1 L	TO15 Ambient
TO-FD-02W	2080304004	Field Sample	Air	0.5 L	1 L	TO15 Ambient
TO-FD-03E	2080304005	Field Sample	Air	0.5 L	1 L	TO15 Ambient
TO-FD-03W	2080304006	Field Sample	Air	0.5 L	1 L	TO15 Ambient

SECTION VII
Batch Summaries

Analysis Batch Summary
VOC
TO15 Ambient

Analysis Batch ID: 54694 **Instrument ID:** GCMSP1 **Analyst:** EDN

Sequence	Client Sample ID	Lab Sample ID	Analysis Date	Analysis Time	Sample Type	Analysis File ID	Sub-Batch ID
1	INSTRUMENT QC	1000	03/20/2008	11:02:00	GC/MS Tune	PA032003.D	0
2	LCS4 for HBN 54694 [VOC/7387]	1071613	03/20/2008	11:02:00	Lab Control Sample	PA032003.D	0
3	LCSD4 for HBN 54694 [VOC/7387]	1071614	03/20/2008	12:04:00	Lab Control Sample Duplicate	PA032004.D	0
4	INSTRUMENT QC	1493	03/20/2008	13:06:00	Continuing Calibration Check	PA032005.D	0
5	MB for HBN 54694 [VOC/7387]	1071615	03/20/2008	14:07:00	Method Blank	PA032006.D	0
6	ZZZZZZZZZZ	2080303401	03/20/2008	15:08:00	Field Sample	PA032007.D	0
7	ZZZZZZZZZZ	2080303501	03/20/2008	15:08:00	Field Sample	PA032007.D	0
8	ZZZZZZZZZZ	2080303402	03/20/2008	16:11:00	Field Sample	PA032008.D	0
9	ZZZZZZZZZZ	2080303502	03/20/2008	16:11:00	Field Sample	PA032008.D	0
10	ZZZZZZZZZZ	2080303403	03/20/2008	17:14:00	Field Sample	PA032009.D	0
11	ZZZZZZZZZZ	2080303503	03/20/2008	17:14:00	Field Sample	PA032009.D	0
12	ZZZZZZZZZZ	1071628	03/20/2008	18:17:00	Duplicate Sample	PA032010.D	0
13	ZZZZZZZZZZ	1071629	03/20/2008	18:17:00	Duplicate Sample	PA032010.D	0
14	ZZZZZZZZZZ	2080303404	03/20/2008	19:21:00	Field Sample	PA032011.D	0
15	ZZZZZZZZZZ	2080303504	03/20/2008	19:21:00	Field Sample	PA032011.D	0
16	ZZZZZZZZZZ	2080303405	03/20/2008	20:27:00	Field Sample	PA032012.D	0
17	ZZZZZZZZZZ	2080303505	03/20/2008	20:27:00	Field Sample	PA032012.D	0
18	TO-FD-01E	2080304001	03/20/2008	21:31:00	Field Sample	PA032013.D	0
19	TO-FD-01W	2080304002	03/20/2008	22:35:00	Field Sample	PA032014.D	0
20	TO-FD-02E	2080304003	03/20/2008	23:39:00	Field Sample	PA032015.D	0
21	TO-FD-02W	2080304004	03/21/2008	00:43:00	Field Sample	PA032016.D	0
22	TO-FD-03E	2080304005	03/21/2008	01:47:00	Field Sample	PA032017.D	0
23	TO-FD-03W	2080304006	03/21/2008	02:52:00	Field Sample	PA032018.D	0
24	ZZZZZZZZZZ	2080303002	03/21/2008	03:51:00	Field Sample	PA032019.D	0
25	ZZZZZZZZZZ	2080303003	03/21/2008	04:51:00	Field Sample	PA032020.D	0
26	ZZZZZZZZZZ	1071630	03/21/2008	05:51:00	Duplicate Sample	PA032021.D	0

SECTION VII
Batch Summaries

Analysis Batch Summary
VOC
TO15 Ambient

Analysis Batch ID: 54798 **Instrument ID:** GCMSP1 **Analyst:** EDN

Sequence	Client Sample ID	Lab Sample ID	Analysis Date	Analysis Time	Sample Type	Analysis File ID	Sub-Batch ID
1	INSTRUMENT QC	1000	03/25/2008	10:49:00	GC/MS Tune	PA032502.D	0
2	INSTRUMENT QC	1493	03/25/2008	10:49:00	Continuing Calibration Check	PA032502.D	0
3	LCS6 for HBN 54798 [VOC/7397]	1071661	03/25/2008	11:51:00	Lab Control Sample	PA032503.D	0
4	LCSD6 for HBN 54798 [VOC/7397]	1071662	03/25/2008	12:54:00	Lab Control Sample Duplicate	PA032504.D	0
5	MB for HBN 54798 [VOC/7397]	1071663	03/25/2008	13:57:00	Method Blank	PA032505.D	0
6	ZZZZZZZZZZ	2080305501	03/25/2008	15:03:00	Field Sample	PA032506.D	0
7	ZZZZZZZZZZ	2080305502	03/25/2008	16:09:00	Field Sample	PA032507.D	0
8	ZZZZZZZZZZ	2080305503	03/25/2008	17:15:00	Field Sample	PA032508.D	0
9	ZZZZZZZZZZ	1071670	03/25/2008	18:21:00	Duplicate Sample	PA032509.D	0
10	ZZZZZZZZZZ	2080305504	03/25/2008	19:27:00	Field Sample	PA032510.D	0
11	ZZZZZZZZZZ	2080305505	03/25/2008	20:33:00	Field Sample	PA032511.D	0
12	TO-FD-01E	2080304001	03/25/2008	21:39:00	Field Sample	PA032512.D	0
13	TO-FD-01W	2080304002	03/25/2008	22:45:00	Field Sample	PA032513.D	0
14	TO-FD-02E	2080304003	03/25/2008	23:51:00	Field Sample	PA032514.D	0
15	TO-FD-02W	2080304004	03/26/2008	00:57:00	Field Sample	PA032515.D	0
16	TO-FD-03E	2080304005	03/26/2008	02:02:00	Field Sample	PA032516.D	0
17	TO-FD-03W	2080304006	03/26/2008	03:08:00	Field Sample	PA032517.D	0

SECTION VIII
Certifications

State/Agency	ID #
Arkansas Department of Environmental Quality	
California Environmental Laboratory Accreditation Program / Waste Water/Hazardous Waste	2411
Kansas Department of Health and Environment / Solid and Hazardous Waste / Wastewater	E-10165
Louisiana Department of Environmental Quality, ELAP / Waste Water/Hazardous Waste/Air Emissions	30736
North Carolina Dept. of Natural Resources & Community Development / Waste Water / Ground Water	302
Oklahoma Department of Environmental Quality/General Water Quality/Sludge	8720
PA Department of Environmental Protection	68-04085
South Carolina Dept. of Health & Environmental Control / Solid & Hazardous Waste / CWA	82003
Texas Commission on Environmental Quality (TCEQ) NELAP	T104704217-06-TX
Texas Department of Public Safety/Precursor Chemical and Lab Apparatus	3039
US Department of Agriculture / Restricted Soils Permit	S-42350

SECTION IX
Notes

The results included in this report have been reviewed for compliance with the laboratory QA/QC plan and meet all requirements of NELAC. All data have been found to be compliant with laboratory protocol except as otherwise noted.

Note that if this report contains tests performed for the following methods, the associated method deviations are applicable:

EPA 410.4, COD:	Use of different analytical wavelength as specified by instrument manufacturer.
EPA 340.2, Fluoride:	Preliminary Bellack distillation not performed.
IOWA OA1:	Benzene, toluene, ethylbenzene and xylenes (BTEX) not analyzed along with Gasoline Range Organics
IOWA OA1 (cont):	if client does not require BTEX.
EPA TO12:	Samples not analyzed in duplicate.
EPA TO14A and TO15:	Zero humidified nitrogen is used in place of air for method blanks.
EPA 624:	Laboratory uses a different desorb time and purge volume than stated in the method.

For all methods that require matrix spike/matrix spike duplicate or laboratory duplicate analyses: In cases where insufficient sample volume is available for method required matrix spike, matrix spike duplicate and/or laboratory duplicate analyses, these QC analyses will not be included in the report.

TRRP Reporting Requirements

If this package contains reports requiring TRRP (Texas Risk Reduction Program) reporting criteria, the following information applies.

The REPORTING LIMIT (RL) is equivalent to the TRRP acronym MQL (method quantitation limit).

The METHOD DETECTION LIMIT (MDL) is equivalent to the TRRP acronym SDL (sample detection limit).

TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

Page 1 of 2

CHAIN-OF-CUSTODY ADDENDUM

Lot No: 20803040

CHECKED/RECEIVED BY: [signature]

COC NUMBER:

DATE/TIME RECEIVED: 3/17/08 08:02

QUOTE/PROFILE: 35709

UNPACKED DATE/TIME: 3/18/08 0730 CC

CLIENT/PROJECT: Entact

SAMPLES LOGGED IN:

LOG-IN REVIEWED: LBV

Number of Shipping Containers Received with Chain of Custody: 1 (6)

VOC AIR / FILTER SAMPLES ☑ YES SEE SECTIONS 1.0, 2.0, & 6.0

1.0 CONTAINERS EXAMINED UPON RECEIPT: CC

Container Sealed: ☑ YES ☐ NO

Custody Seal Signed/Dated: ☐ YES ☑ NO

Custody Seal Present: ☐ YES ☑ NO

If seal not intact list air bill number of that container(s):

2.0 VOC CANISTERS EXAMINED UPON RECEIPT: CC

Canister Valves Closed: ☑ YES ☐ NO

Samples Received Match Chain: ☑ YES ☐ NO

Canister Valves Capped: ☑ YES ☐ NO

Other Equipment Received: ☑ YES ☐ NO

Valve Cap Tightened Properly: ☑ YES ☐ NO

See Additional Comments (Section 5.0 and / or 7.0) ☐ YES ☑ NO

Packing Material Used: (circle)

Chain-of-Custody form properly maintained: ☑ YES ☐ NO

None / Absorbent / Paper / Bubble Wrap

Can Size: ☑ 6L ☐ 15L Other

3.0 SAMPLE TEMPERATURE UPON RECEIPT BY: IR THERMOMETER #: ☐ P4 ☐ P5

Temperature of the container(s):

Circle selection: TB = Temp. Blank and/or SC = Sample Container CF = Correction Factor [*acceptable tolerance 4°C ± 2°*]

TB ☐ SC ☐	TB ☐ SC ☐	TB ☐ SC ☐	TB ☐ SC ☐	TB ☐ SC ☐	TB ☐ SC ☐	TB ☐ SC ☐	TB ☐ SC ☐
Initial	Initial	Initial	Initial	Initial	Initial	Initial	Initial
CF	CF	CF	CF	CF	CF	CF	CF
Final	Final	Final	Final	Final	Final	Final	Final

If temperature is outside acceptable tolerance, Project Manager was notified (_____PM). Date: _____ Time: _____

Samples received do not require cooling _____ OK to analyze samples: ☐ YES ☐ NO

PRESERVATION OF SAMPLES REQUIRED: ☐ NA ☐ YES ☐ VOA Samples **VERIFIED BY:**

NOTE: pH CHECK OF SAMPLES FOR 1664A ANALYSIS CHECK AT TIME OF ANALYSIS BY BENCH ANALYST
pH CHECK OF VOLATILE SAMPLES PERFORMED AFTER ANALYSIS BY THE BENCH ANALYST.

Base samples are>pH 12: ☐ YES ☐ NO

Acid preserved are<pH 2: ☐ YES ☐ NO

Cyanide samples checked for sulfides: ☐ YES

Sulfide samples appear to be preserved with zinc acetate: ☐ YES ☐ NO

Samples checked for chlorine per specification (N.C.) ☐ YES

Free chlorine present: ☐ YES ☐ NO

If sample preservation is outside acceptable tolerance, Project Manager was notified (_____PM)

Date: _____ Time: _____ ☐ see pH adjustment form

VOLATILE SAMPLES FILLED COMPLETELY, IF NOT, LIST ID AND HEADSPACE OF VOA's CONTAINING BUBBLES EXCEEDING 6MM IN DIAMETER:

Sample ID	mm Headspace	Sample ID	mm Headspace

Revised 10/17/07

TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

CHAIN-OF-CUSTODY ADDENDUM

Lot No: _____

4.0 CONDITION OF BOTTLES/CONTAINERS **VERIFIED BY:** _____

Samples received match COC:	☐ YES	☐ NO	Bottles received intact:	☐ YES	☐ NO
See additional discrepancies/comments section:	☐ YES	☐ NO	Samples received from USDA restricted area:	☐ YES	☐ NO
Chain-of-Custody form properly maintained:	☐ YES	☐ NO	VOA trip blanks included:	☐ YES ☐ NO	☐ N/A

5.0 ADDITIONAL DISCREPANCIES

Appears on COC		Appears on Label		
Sample ID	Date/Time	Sample ID	Date/Time	Comments

6.0 SHIPPING DOCUMENTATION:

Air/freight bill is available and attached to COC: ☑ YES ☐ NO Air bill #: _____

Hand-delivered Carrier: _____ Date: _____ Time: _____

7.0 OTHER COMMENTS:

Received GX VFR SN# 7300138, 7300954, 7301018
7300947, 7259272, 7301137

CORRECTIVE ACTION:

Client's Name: _____ Informed verbally on: _____ By: _____

Client's Name: _____ Informed verbally on: _____ By: _____

Sample(s) processed "as is" comments: _____

Samples(s) on hold until: _____ If released, notify: _____

REVIEW:

Project Management: _____ Date: 3/18/08

SIGNED ORIGINAL MUST BE RETAINED IN THE PROJECT FILE

TestAmerica - Austin
14050 Summit Drive
Suite A-100
Austin, TX 78728
Tel. 512-244-0855 Fax 512-244-0160

VOC Chain of Custody Record

Page ____ of ____

ENTACT - Impex Crawfordsville

COLLECTED BY (Signature): Aaron McCorvey

FIELD I.D.	SITE	CANISTER #	SAMPLING: DATE	START TIME	END TIME	SAMPLING TYPE: ROUTINE	DUPLICATE	FIELD BLANK	EVENT	VOID	ANALYSIS: AMBIENT GC/MD	AMBIENT GC/MS	SOURCE GC/MD	SOURCE GC/MS	FIXED GASES	FIELD: INITIAL PRESSURE (PSIG)	FINAL PRESSURE (PSIG)
TO-FD-01E	Impex Crawford	5424	3-7-08	10:30	10:30	X										-30	0
TO-FD-01W	Impex Crawford	5416	3-7-08	10:30	10:30	X										-30	-5
TO-FD-02E	"	5447	3-11-08	09:00	09:00	X										-25	-5
TO-FD-02W	"	5438	3-11-08	09:00	09:00	X										-25	-10
TO-FD-03E	"	5465	3-12-08	09:00	09:00	X										-30	-5
TO-FD-03W	"	5426	3-12-08	09:00	09:00	X										-30	-5

CONVERSION FACTOR: Hg x 0.49116 = PSIG

REMARKS:
ENTACT
3129 Bass Pro Drive
Grapevine, TX 76051

contact
Aaron McCorvey
630-935-9459
amccorvey@entact.com

RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME
Aaron McCorvey	3-17-08										

LAB USE ONLY

RECEIVED FOR LABORATORY BY:	DATE	TIME	AIRBILL NO.	WORK ORDER NUMBER:	SHELF LOCATION:	# OF VFR'S	# OF FILTERS
	3-17-08	0900		20803040			

VOC PREP REPORT (by HSN)

HSN	Canister ID	Prep Date	Initial Pressure (PSIG)	Final Pressure (PSIG)	Final Pressure ("Hg)	Diluent Added	Initial Dilution Factor	Primary Dilution Factor	Final Dilution
2080304001	5424	3/20/2008 15:36:41	-14.05	0.7	0	22.5	1	2.522	2.522
2080304002	5416	3/20/2008 15:36:42	-14.05	-1.5717	3.2	22.5	1	2.9812	2.9812
2080304003	5447	3/20/2008 15:37:00	-14.05	-1.8664	3.8	22.5	1	3.0533	3.0533
2080304004	5438	3/20/2008 15:37:17	-14.05	-4.1257	8.4	22.6	1	3.7585	3.7585
2080304005	5465	3/20/2008 15:37:59	-14.05	-1.9646	4	22.5	1	3.0781	3.0781
2080304006	5426	3/20/2008 15:38:32	-14.05	-1.6699	3.4	22.5	1	3.0048	3.0048

PEER REVIEWED BY _____

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

ANALYTICAL REPORT

Job Number: 560-9081-1

Job Description: Crawfordsville,IN

For:
Entact, LLC
3129 Bass Pro Drive
Grapevine, TX 76051

Attention: Mr. Aaron McCorvey

Julie Darrow
Project Manager I
julie.darrow@testamericainc.com
03/28/2008

The test results entered in this report meet all NELAC requirements for accredited parameters. Any exceptions to NELAC requirements are noted in the report. Pursuant to NELAC, this report may not be reproduced except in full, and with written approval from the laboratory. TestAmerica Corpus Christi Certifications and Approvals: NELAC TX T104704210-06-TX, NELAC KS E-10362, Oklahoma 9968, USDA Soil Permit S-42935 Revised.

US EPA ARCHIVE DOCUMENT

TestAmerica Laboratories, Inc.
TestAmerica Corpus Christi 1733 N. Padre Island Drive, Corpus Christi, TX 78408
Tel (361) 289-2673 Fax (361) 289-2471 www.testamericainc.com

ACCREDITED IN ACCORDANCE WITH nelac

Volatile Orgaincs Analysis

Sample 560-9081-1 was analyzed for volatile orgainics using EPA 8260C in batch 560-21194. During the extraction process, the spiking compounds were inadvertently omitted. Therefore, matrix spike and matrix spike duplicate recoveries were not available.The method blank and LCS were within acceptable limits and the data are therefore reported.

No other analytical or quality issues were noted.

EXECUTIVE SUMMARY - Detections

Client: Entact, LLC Job Number: 560-9081-1

Lab Sample ID / Analyte	Client Sample ID	Result / Qualifier		Reporting Limit	Units	Method
560-9081-1	**FD-S88-PRE**					
cis-1,2-Dichloroethene		400	J	490	ug/Kg	8260B
TCE		4900		490	ug/Kg	8260B
Percent Moisture		6.2		0.010	%	PercentMoisture
Percent Solids		94		0.010	%	PercentMoisture

METHOD SUMMARY

Client: Entact, LLC Job Number: 560-9081-1

Description	Lab Location	Method	Preparation Method
Matrix Solid			
Volatile Organic Compounds by GC/MS	TAL CC	SW846 8260B	
Closed System Purge & Trap/Laboratory Preservation	TAL CC		SW846 5035

Lab References:

TAL CC = TestAmerica Corpus Christi

Method References:

SW846 = "Test Methods For Evaluating Solid Waste, Physical/Chemical Methods", Third Edition, November 1986 And Its Updates.

METHOD / ANALYST SUMMARY

Client: Entact, LLC

Job Number: 560-9081-1

Method	Analyst	Analyst ID
SW846 8260B	Newman, David	DN
EPA PercentMoisture	Zwierzykowski, Hanna M	HMZ

SAMPLE SUMMARY

Client: Entact, LLC

Job Number: 560-9081-1

Lab Sample ID	Client Sample ID	Client Matrix	Date/Time Sampled	Date/Time Received
560-9081-1	FD-S88-PRE	Solid	03/07/2008 1030	03/10/2008 0850

SAMPLE RESULTS

Client: Entact, LLC

Job Number: 560-9081-1

Client Sample ID: **FD-S88-PRE**

Lab Sample ID: 560-9081-1
Client Matrix: Solid
% Moisture: 6.2
Date Sampled: 03/07/2008 1030
Date Received: 03/10/2008 0850

8260B Volatile Organic Compounds by GC/MS

Method: 8260B
Preparation: 5035
Dilution: 50
Date Analyzed: 03/11/2008 1139
Date Prepared: 03/11/2008 0907
Analysis Batch: 560-21194
Prep Batch: 560-21180
Instrument ID: VGCMS#2
Lab File ID: 03110707.D
Initial Weight/Volume: 5.43 g
Final Weight/Volume: 10 mL

Analyte	DryWt Corrected: Y	Result (ug/Kg)	Qualifier	MDL	RL
Vinyl chloride		<490		49	490
cis-1,2-Dichloroethene		400	J	49	490
TCE		4900		49	490

Surrogate	%Rec	Acceptance Limits
Dibromofluoromethane (Surr)	105	59 - 120
1,2-Dichloroethane-d4 (Surr)	111	71 - 120
4-Bromofluorobenzene (Surr)	103	47 - 120
Toluene-d8 (Surr)	109	57 - 120

General Chemistry

Client Sample ID: FD-S88-PRE

Lab Sample ID: 560-9081-1 Date Sampled: 03/07/2008 1030
Client Matrix: Solid Date Received: 03/10/2008 0850

Analyte	Result	Qual	Units	RL	RL	Dil	Method
Percent Moisture	6.2		%	0.010	0.010	1.0	PercentMoisture
Anly Batch: 560-21169	Date Analyzed		03/10/2008 1330				
Percent Solids	94		%	0.010	0.010	1.0	PercentMoisture
Anly Batch: 560-21169	Date Analyzed		03/10/2008 1330				

DATA REPORTING QUALIFIERS

Client: Entact, LLC Job Number: 560-9081-1

Lab Section	Qualifier	Description
GC/MS VOA		
	J	Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.

QUALITY CONTROL RESULTS

Client: Entact, LLC

Job Number: 560-9081-1

QC Association Summary

Lab Sample ID	Client Sample ID	Report Basis	Client Matrix	Method	Prep Batch
GC/MS VOA					
Prep Batch: 560-21180					
LCS 560-21180/1-A	Lab Control Spike	T	Solid	5035	
MB 560-21180/2-A	Method Blank	T	Solid	5035	
560-9081-1	FD-S88-PRE	T	Solid	5035	
Analysis Batch:560-21194					
LCS 560-21180/1-A	Lab Control Spike	T	Solid	8260B	560-21180
MB 560-21180/2-A	Method Blank	T	Solid	8260B	560-21180
560-9081-1	FD-S88-PRE	T	Solid	8260B	560-21180

Report Basis
T = Total

General Chemistry

Analysis Batch:560-21169					
560-9081-1	FD-S88-PRE	T	Solid	PercentMoisture	
560-9081-1DU	Duplicate	T	Solid	PercentMoisture	

Report Basis
T = Total

Client: Entact, LLC

Job Number: 560-9081-1

Method Blank - Batch: 560-21180

Method: 8260B
Preparation: 5035

Lab Sample ID: MB 560-21180/2-A
Client Matrix: Solid
Dilution: 50
Date Analyzed: 03/11/2008 1045
Date Prepared: 03/11/2008 0907

Analysis Batch: 560-21194
Prep Batch: 560-21180
Units: ug/Kg

Instrument ID: VGCMS#2
Lab File ID: 03110705.D
Initial Weight/Volume: 5 g
Final Weight/Volume: 10 mL

Analyte	Result	Qual	MDL	RL
Vinyl chloride	<500		50	500
cis-1,2-Dichloroethene	<500		50	500
TCE	<500		50	500

Surrogate	% Rec	Acceptance Limits
Dibromofluoromethane (Surr)	109	59 - 120
1,2-Dichloroethane-d4 (Surr)	111	71 - 120
4-Bromofluorobenzene (Surr)	102	47 - 120
Toluene-d8 (Surr)	114	57 - 120

Lab Control Spike - Batch: 560-21180

Method: 8260B
Preparation: 5035

Lab Sample ID: LCS 560-21180/1-A
Client Matrix: Solid
Dilution: 50
Date Analyzed: 03/11/2008 0954
Date Prepared: 03/11/2008 0907

Analysis Batch: 560-21194
Prep Batch: 560-21180
Units: ug/Kg

Instrument ID: VGCMS#2
Lab File ID: 03110703.D
Initial Weight/Volume: 5 g
Final Weight/Volume: 10 mL

Analyte	Spike Amount	Result	% Rec.	Limit	Qual
Vinyl chloride	5000	3670	73	58 - 126	
cis-1,2-Dichloroethene	5000	4730	95	67 - 125	
TCE	5000	5120	102	77 - 124	

Surrogate	% Rec	Acceptance Limits
Dibromofluoromethane (Surr)	107	59 - 120
1,2-Dichloroethane-d4 (Surr)	107	71 - 120
4-Bromofluorobenzene (Surr)	101	47 - 120
Toluene-d8 (Surr)	105	57 - 120

Calculations are performed before rounding to avoid round-off errors in calculated results.

Client: Entact, LLC

Job Number: 560-9081-1

Duplicate - Batch: 560-21169

Method: PercentMoisture
Preparation: N/A

Lab Sample ID: 560-9081-1
Client Matrix: Solid
Dilution: 1.0
Date Analyzed: 03/10/2008 1330
Date Prepared: N/A

Analysis Batch: 560-21169
Prep Batch: N/A
Units: %

Instrument ID: No Equipment Assigned
Lab File ID: N/A
Initial Weight/Volume:
Final Weight/Volume:

Analyte	Sample Result/Qual	Result	RPD	Limit	Qual
Percent Moisture	6.2	5.8	8	20	
Percent Solids	94	94	0	20	

Calculations are performed before rounding to avoid round-off errors in calculated results.

Client: Entact, LLC

Job Number: 560-9081-1

Laboratory Chronicle

Lab ID: 560-9081-1 **Client ID: FD-S88-PRE**

Sample Date/Time: 03/07/2008 10:30 Received Date/Time: 03/10/2008 08:50

Method	Bottle ID	Run	Analysis Batch	Prep Batch	Date Prepared / Analyzed	Dil	Lab	Analyst
P:5035	560-9081-C-1-A		560-21194	560-21180	03/11/2008 09:07	50	TAL CC	DN
A:8260B	560-9081-C-1-A		560-21194	560-21180	03/11/2008 11:39	50	TAL CC	DN
A:PercentMoisture	560-9081-A-1		560-21169		03/10/2008 13:30	1	TAL CC	HMZ

Lab ID: 560-9081-1 DU **Client ID: FD-S88-PRE**

Sample Date/Time: 03/07/2008 10:30 Received Date/Time: 03/10/2008 08:50

Method	Bottle ID	Run	Analysis Batch	Prep Batch	Date Prepared / Analyzed	Dil	Lab	Analyst
A:PercentMoisture	560-9081-A-1 DU		560-21169		03/10/2008 13:30	1	TAL CC	HMZ

Lab ID: MB **Client ID: N/A**

Sample Date/Time: N/A Received Date/Time: N/A

Method	Bottle ID	Run	Analysis Batch	Prep Batch	Date Prepared / Analyzed	Dil	Lab	Analyst
P:5035	MB 560-21180/2-A		560-21194	560-21180	03/11/2008 09:07	50	TAL CC	DN
A:8260B	MB 560-21180/2-A		560-21194	560-21180	03/11/2008 10:45	50	TAL CC	DN

Lab ID: LCS **Client ID: N/A**

Sample Date/Time: N/A Received Date/Time: N/A

Method	Bottle ID	Run	Analysis Batch	Prep Batch	Date Prepared / Analyzed	Dil	Lab	Analyst
P:5035	LCS 560-21180/1-A		560-21194	560-21180	03/11/2008 09:07	50	TAL CC	DN
A:8260B	LCS 560-21180/1-A		560-21194	560-21180	03/11/2008 09:54	50	TAL CC	DN

Lab References:
TAL CC = TestAmerica Corpus Christi

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

3.5C 1125 9081

TAL-4142 (0907)

Client	Project Manager	Date	Chain of Custody Number
ENTACT		3-7-08	364050
Address	**Telephone Number (Area Code)/Fax Number**	**Lab Number**	**Page** 1 of 1
3109 Bass Pro Drive	630-935-9459		
City / **State** / **Zip Code**	**Site Contact**	**Lab Contact**	
Grapevine / TX / 76051	Aaron McCorvey		
Project Name and Location (State)	**Carrier/Waybill Number**		
Former Impex - Crawfordsville, IN			
Contract/Purchase Order/Quote No.			

Sample I.D. No. and Description (Containers for each sample may be combined on one line)	Date	Time	Matrix: Air	Aqueous	Sed.	Soil	Containers & Preservatives: Unpres.	H2SO4	HNO3	HCl	NaOH	ZnAc/ NaOH	Analysis: TCE	Vinyl Chloride	cis 1,2-DCE	Special Instructions/ Conditions of Receipt
FD-S88-Pre	3-7-08	10:30				X							X	X	X	(3) Encore devices 4 oz glass jar

Page 16 of 17

Possible Hazard Identification
☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal
☐ Return To Client ☐ Disposal By Lab ☐ Archive For _____ Months
(A fee may be assessed if samples are retained longer than 1 month)

Turn Around Time Required
☒ 24 Hours ☐ 48 Hours ☐ 7 Days ☐ 14 Days ☐ 21 Days ☐ Other _____

QC Requirements (Specify)

	Date	Time
1. Relinquished By: Aaron McCorvey	3-7-08	
2. Relinquished By: FedEx		
3. Relinquished By:		

	Date	Time
1. Received By: FedEx 868455500 43		
2. Received By:	03/10/08	0850
3. Received By:		

Comments

03/28/2008

DISTRIBUTION: WHITE - Returned to Client with Report; CANARY - Stays with the Sample; PINK - Field Copy

Login Sample Receipt Check List

Client: Entact, LLC

Job Number: 560-9081-1

Login Number: 9081
List Source: TestAmerica Corpus Christi
Creator: McDermott, Vivian
List Number: 1

Question	T / F/ NA	Comment
Radioactivity either was not measured or, if measured, is at or below background	N/A	
The cooler's custody seal, if present, is intact.	True	
The cooler or samples do not appear to have been compromised or tampered with.	True	
Samples were received on ice.	True	
Cooler Temperature is acceptable.	True	
Cooler Temperature is recorded.	True	3.3C IR 5
COC is present.	True	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	True	
There are no discrepancies between the sample IDs on the containers and the COC.	True	
Samples are received within Holding Time.	False	HELD AT FED EX DUE TO WEATHER
Sample containers have legible labels.	True	
Containers are not broken or leaking.	True	
Sample collection date/times are provided.	True	
Appropriate sample containers are used.	True	
Sample bottles are completely filled.	True	
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs	True	
VOA sample vials do not have headspace or bubble is <6mm (1/4") in diameter.	N/A	
If necessary, staff have been informed of any short hold time or quick TAT needs	True	
Multiphasic samples are not present.	True	
Samples do not require splitting or compositing.	True	

Pace Analytical Services, Inc.
7726 Moller Road
Indianapolis, IN 46268
(317)875-5894

March 14, 2008

Mr. Jason Cosgrove
Arcadis U.S., Inc.
251 E. Ohio Street
Suite 800
Indianapolis, IN 46204

RE: Project: Valhi, Crawfordsville, IN
Pace Project No.: 5012923

Dear Mr. Cosgrove:
Enclosed are the analytical results for sample(s) received by the laboratory on March 13, 2008. The results relate only to the samples included in this report. Results reported herein conform to the most current NELAC standards, where applicable, unless otherwise narrated in the body of the report.

If you have any questions concerning this report, please feel free to contact me.

Sincerely,

Donna S. Spyker

Donna Spyker

dspyker@pacelabs.com
Project Manager

Illinois/NELAC Certification Number: 100418
Indiana Certification Number: C-49-06
Kansas Certification Number: E-10247
Kentucky Certification Number: 0042
Ohio VAP: CL0065
Pennsylvania: 68-00791
West Virginia Certification Number: 330

Enclosures

Pace Analytical Services, Inc.
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Indianapolis, IN 46268
(317)875-5894

SAMPLE SUMMARY

Project: Valhi, Crawfordsville, IN
Pace Project No.: 5012923

Lab ID	Sample ID	Matrix	Date Collected	Date Received
5012923001	**FD- AB23-Pre**	Solid	03/13/08 10:43	03/13/08 14:04
5012923002	**FD- AB23- Arc**	Solid	03/13/08 10:43	03/13/08 14:04

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SAMPLE ANALYTE COUNT

Project: Valhi, Crawfordsville, IN
Pace Project No.: 5012923

Lab ID	Sample ID	Method	Analysts	Analytes Reported
5012923001	**FD- AB23-Pre**	ASTM D2974-87	ILP	1
		EPA 8260	JLF	6
5012923002	**FD- AB23- Arc**	ASTM D2974-87	ILP	1
		EPA 8260	JLF	6

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ANALYTICAL RESULTS

Project: Valhi, Crawfordsville, IN
Pace Project No.: 5012923

Sample: FD- AB23-Pre **Lab ID: 5012923001** Collected: 03/13/08 10:43 Received: 03/13/08 14:04 Matrix: Solid

Results reported on a "dry-weight" basis

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
8260 MSV 5035A VOA	Analytical Method: EPA 8260							
cis-1,2-Dichloroethene	**6880**	ug/kg	2300	500		03/14/08 02:12	156-59-2	
Trichloroethene	**48600**	ug/kg	2300	500		03/14/08 02:12	79-01-6	
Vinyl chloride	**297**	ug/kg	230	50		03/14/08 14:18	75-01-4	
Dibromofluoromethane (S)	90	%	80-124	50		03/14/08 14:18	1868-53-7	
Toluene-d8 (S)	99	%	58-145	50		03/14/08 14:18	2037-26-5	
4-Bromofluorobenzene (S)	95	%	61-131	50		03/14/08 14:18	460-00-4	
Percent Moisture	Analytical Method: ASTM D2974-87							
Percent Moisture	**10.0**	%	0.10	1		03/13/08 14:59		

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ANALYTICAL RESULTS

Project: Valhi, Crawfordsville, IN
Pace Project No.: 5012923

Sample: FD- AB23- Arc **Lab ID: 5012923002** Collected: 03/13/08 10:43 Received: 03/13/08 14:04 Matrix: Solid

Results reported on a "dry-weight" basis

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
8260 MSV 5030 Low Level	Analytical Method: EPA 8260							
cis-1,2-Dichloroethene	**7300**	ug/kg	2760	500		03/14/08 02:46	156-59-2	
Trichloroethene	**53500**	ug/kg	2760	500		03/14/08 02:46	79-01-6	
Vinyl chloride	ND	ug/kg	276	50		03/14/08 14:36	75-01-4	
Dibromofluoromethane (S)	90	%	80-124	50		03/14/08 14:36	1868-53-7	
Toluene-d8 (S)	100	%	58-145	50		03/14/08 14:36	2037-26-5	
4-Bromofluorobenzene (S)	98	%	61-131	50		03/14/08 14:36	460-00-4	
Percent Moisture	Analytical Method: ASTM D2974-87							
Percent Moisture	**9.3**	%	0.10	1		03/13/08 14:59		

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QUALITY CONTROL DATA

Project: Valhi, Crawfordsville, IN
Pace Project No.: 5012923

QC Batch: PMST/2334
QC Batch Method: ASTM D2974-87
Analysis Method: ASTM D2974-87
Analysis Description: Dry Weight/Percent Moisture
Associated Lab Samples: 5012923001, 5012923002

SAMPLE DUPLICATE: 142180

Parameter	Units	5012923001 Result	Dup Result	RPD	Max RPD	Qualifiers
Percent Moisture	%	10.0	10.0	0	5	

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QUALITY CONTROL DATA

Project: Valhi, Crawfordsville, IN
Pace Project No.: 5012923

QC Batch: MSV/7982
QC Batch Method: EPA 8260
Analysis Method: EPA 8260
Analysis Description: 8260 MSV 5035A Volatile Organics
Associated Lab Samples: 5012923001

METHOD BLANK: 142786
Associated Lab Samples: 5012923001

Parameter	Units	Blank Result	Reporting Limit	Qualifiers
cis-1,2-Dichloroethene	ug/kg	ND	5.0	
Trichloroethene	ug/kg	ND	5.0	
Vinyl chloride	ug/kg	ND	5.0	
4-Bromofluorobenzene (S)	%	95	61-131	
Dibromofluoromethane (S)	%	92	80-124	
Toluene-d8 (S)	%	101	58-145	

LABORATORY CONTROL SAMPLE: 142787

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
cis-1,2-Dichloroethene	ug/kg	50	49.6	99	76-119	
Trichloroethene	ug/kg	50	46.9	94	74-121	
Vinyl chloride	ug/kg	50	46.9	94	50-146	
4-Bromofluorobenzene (S)	%			93	61-131	
Dibromofluoromethane (S)	%			90	80-124	
Toluene-d8 (S)	%			102	58-145	

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QUALITY CONTROL DATA

Project: Valhi, Crawfordsville, IN
Pace Project No.: 5012923

QC Batch: MSV/7983
QC Batch Method: EPA 8260
Analysis Method: EPA 8260
Analysis Description: 8260 MSV 5030 Low
Associated Lab Samples: 5012923002

METHOD BLANK: 142788
Associated Lab Samples: 5012923002

Parameter	Units	Blank Result	Reporting Limit	Qualifiers
cis-1,2-Dichloroethene	ug/kg	ND	5.0	
Trichloroethene	ug/kg	ND	5.0	
Vinyl chloride	ug/kg	ND	5.0	
4-Bromofluorobenzene (S)	%	93	61-131	
Dibromofluoromethane (S)	%	93	80-124	
Toluene-d8 (S)	%	99	58-145	

LABORATORY CONTROL SAMPLE: 142789

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
cis-1,2-Dichloroethene	ug/kg	50	58.4	117	76-119	
Trichloroethene	ug/kg	50	51.4	103	74-121	
Vinyl chloride	ug/kg	50	44.7	89	50-146	
4-Bromofluorobenzene (S)	%			96	61-131	
Dibromofluoromethane (S)	%			91	80-124	
Toluene-d8 (S)	%			101	58-145	

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QUALIFIERS

Project: Valhi, Crawfordsville, IN
Pace Project No.: 5012923

DEFINITIONS

DF - Dilution Factor, if reported, represents the factor applied to the reported data due to changes in sample preparation, dilution of the sample aliquot, or moisture content.

ND - Not Detected at or above adjusted reporting limit.

J - Estimated concentration above the adjusted method detection limit and below the adjusted reporting limit.

MDL - Adjusted Method Detection Limit.

S - Surrogate

1,2-Diphenylhydrazine (8270 listed analyte) decomposes to Azobenzene.

Consistent with EPA guidelines, unrounded data are displayed and have been used to calculate % recovery and RPD values.

LCS(D) - Laboratory Control Sample (Duplicate)

MS(D) - Matrix Spike (Duplicate)

DUP - Sample Duplicate

RPD - Relative Percent Difference

NC - Not Calculable.

Pace Analytical is NELAP accredited. Contact your Pace PM for the current list of accredited analytes.

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

TAL-4142 (0907)

Client: Arcadis	Project Manager: Donna / Jason Cosgrove	Date: 3-13-08	Chain of Custody Number: 364151
Address:	Telephone Number (Area Code)/Fax Number:	Lab Number:	Page 1 of 1
City:	State:	Zip Code:	Site Contact: Jason
Lab Contact: Donna Spyker	Project Name and Location (State): Valhi, Crawfordsville, IN	Carrier/Waybill Number:	Contract/Purchase Order/Quote No.:

24 hr TURN

Special Instructions/ Conditions of ~~Receipt~~

5012923

Sample I.D. No. and Description (Containers for each sample may be combined on one line)	Date	Time	Matrix: Air	Aqueous	Sed.	Soil	Containers & Preservatives: Unpres.	H_2SO_4	HNO_3	HCl	NaOH	ZnAc/ NaOH	Analysis: TCE	cis 1,2-DCE	Vinyl Chloride	
FD-AB23-Pre	3-13-08	10:43				X							X	X	X	3 encore & 1 4oz. jar 001
FD-AB23-Arc	3-13-08	10:43				X							X	X	X	2-4 oz. jar 002

Possible Hazard Identification
☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal
☐ Return To Client ☐ Disposal By Lab ☐ Archive For _____ Months
(A fee may be assessed if samples are retained longer than 1 month)

Turn Around Time Required
☐ 24 Hours ☐ 48 Hours ☐ 7 Days ☐ 14 Days ☐ 21 Days ☐ Other _____

QC Requirements (Specify)

	Date	Time		Date	Time
1. Relinquished By	3/13/08	2:04p	1. Received By: Lw Childs pace	3-13-08	2:04p
2. Relinquished By			2. Received By		
3. Relinquished By			3. Received By		

Comments
Rush - 24 hour Turn around

DISTRIBUTION: WHITE - Returned to Client with Report; CANARY - Stays with the Sample; PINK - Field Copy

Cooler WI Client del.

Sample Condition Upon Receipt

Pace Analytical

Client Name: Arcadis Project # 5012923

Courier: ☐ Fed Ex ☐ UPS ☐ USPS ☒ Client ☐ Commercial ☐ Pace Other _____

Tracking #: _____

Custody Seal on Cooler/Box Present: ☐ yes ☒ no Seals intact: ☐ yes ☒ no

Packing Material: ☐ Bubble Wrap ☐ Bubble Bags ☒ None ☐ Other _____

Thermometer Used 1234 **Type of Ice:** (Wet) Blue None ☐ Samples on ice, cooling process has begun

Cooler Temperature 7.6°C **Biological Tissue is Frozen:** Yes (No)

Temp should be above freezing to 6°C

Comments:

Date and Initials of person examining contents: 2/3/08

Chain of Custody Present:	☒Yes ☐No ☐N/A	1.
Chain of Custody Filled Out:	☒Yes ☐No ☐N/A	2.
Chain of Custody Relinquished:	☒Yes ☐No ☐N/A	3.
Sampler Name & Signature on COC:	☒Yes ☐No ☐N/A	4.
Samples Arrived within Hold Time:	☒Yes ☐No ☐N/A	5.
Short Hold Time Analysis (<72hr):	☒Yes ☐No ☐N/A	6. Arcades
Rush Turn Around Time Requested: 24hr.	☒Yes ☐No ☐N/A	7.
Sufficient Volume:	☒Yes ☐No ☐N/A	8.
Correct Containers Used:	☒Yes ☐No ☐N/A	9.
-Pace Containers Used:	☒Yes ☐No ☐N/A	
Containers Intact:	☒Yes ☐No ☐N/A	10.
Filtered volume received for Dissolved tests	☐Yes ☐No ☒N/A	11.
Sample Labels match COC:	☒Yes ☐No ☐N/A	12.
-Includes date/time/ID/Analysis Matrix: Soil		
All containers needing preservation have been checked.	☐Yes ☐No ☒N/A	13.
All containers needing preservation are found to be in compliance with EPA recommendation.	☐Yes ☐No ☒N/A	
exceptions: VOA, coliform, TOC, O&G, WI-DRO (water)	☐Yes ☐No	Initial when completed / Lot # of added preservative
Samples checked for dechlorination:	☐Yes ☐No ☒N/A	14.
Headspace in VOA Vials (>6mm):	☐Yes ☐No ☒N/A	15.
Trip Blank Present:	☐Yes ☐No ☒N/A	16.
Trip Blank Custody Seals Present	☐Yes ☐No ☒N/A	
Pace Trip Blank Lot # (if purchased):		

Client Notification/ Resolution: Field Data Required? Y / N

Person Contacted: _____ Date/Time: _____

Comments/ Resolution: _____

Project Manager Review: K. Jones **Date:** 3-13-08

Note: Whenever there is a discrepancy affecting North Carolina compliance samples, a copy of this form will be sent to the North Carolina DEHNR Certification Office (i.e out of hold, incorrect preservative, out of temp, incorrect containers)

Pace Analytical Services, Inc.
7726 Moller Road
Indianapolis, IN 46268
(317)875-5894

March 20, 2008

Mr. Jason Cosgrove
Arcadis U.S., Inc.
251 E. Ohio Street
Suite 800
Indianapolis, IN 46204

RE: Project: Valhi
Pace Project No.: 5012998

Dear Mr. Cosgrove:
Enclosed are the analytical results for sample(s) received by the laboratory on March 14, 2008. The results relate only to the samples included in this report. Results reported herein conform to the most current NELAC standards, where applicable, unless otherwise narrated in the body of the report.

If you have any questions concerning this report, please feel free to contact me.

Sincerely,

Donna S. Spyker

Donna Spyker

dspyker@pacelabs.com
Project Manager

Illinois/NELAC Certification Number: 100418
Indiana Certification Number: C-49-06
Kansas Certification Number: E-10247
Kentucky Certification Number: 0042
Ohio VAP: CL0065
Pennsylvania: 68-00791
West Virginia Certification Number: 330

Enclosures

Pace Analytical Services, Inc.
7726 Moller Road
Indianapolis, IN 46268
(317)875-5894

SAMPLE SUMMARY

Project: Valhi
Pace Project No.: 5012998

Lab ID	Sample ID	Matrix	Date Collected	Date Received
5012998001	**FD-AB23-Post**	Solid	03/14/08 08:00	03/14/08 12:46

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Indianapolis, IN 46268
(317)875-5894

SAMPLE ANALYTE COUNT

Project: Valhi
Pace Project No.: 5012998

Lab ID	Sample ID	Method	Analysts	Analytes Reported
5012998001	**FD-AB23-Post**	ASTM D2974-87	ILP	1
		EPA 8260	JLF	6

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Indianapolis, IN 46268
(317)875-5894

ANALYTICAL RESULTS

Project: Valhi
Pace Project No.: 5012998

Sample: FD-AB23-Post **Lab ID: 5012998001** Collected: 03/14/08 08:00 Received: 03/14/08 12:46 Matrix: Solid

Results reported on a "dry-weight" basis

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
8260 MSV 5035A VOA	Analytical Method: EPA 8260							
cis-1,2-Dichloroethene	**629**	ug/kg	257	50		03/20/08 00:33	156-59-2	
Trichloroethene	**6340**	ug/kg	257	50		03/20/08 00:33	79-01-6	
Vinyl chloride	ND	ug/kg	5.1	1		03/19/08 23:58	75-01-4	
Dibromofluoromethane (S)	20	%	80-124	1		03/19/08 23:58	1868-53-7	S5
Toluene-d8 (S)	102	%	58-145	1		03/19/08 23:58	2037-26-5	
4-Bromofluorobenzene (S)	92	%	61-131	1		03/19/08 23:58	460-00-4	
Percent Moisture	Analytical Method: ASTM D2974-87							
Percent Moisture	**15.1**	%	0.10	1		03/17/08 16:59		

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QUALITY CONTROL DATA

Project: Valhi
Pace Project No.: 5012998

QC Batch: PMST/2340
QC Batch Method: ASTM D2974-87
Analysis Method: ASTM D2974-87
Analysis Description: Dry Weight/Percent Moisture
Associated Lab Samples: 5012998001

SAMPLE DUPLICATE: 143665

Parameter	Units	5012998001 Result	Dup Result	RPD	Max RPD	Qualifiers
Percent Moisture	%	15.1	16.8	10	5	R2

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Indianapolis, IN 46268
(317)875-5894

QUALITY CONTROL DATA

Project: Valhi
Pace Project No.: 5012998

QC Batch: MSV/8110
QC Batch Method: EPA 8260
Analysis Method: EPA 8260
Analysis Description: 8260 MSV 5035A Volatile Organics
Associated Lab Samples: 5012998001

METHOD BLANK: 145027
Associated Lab Samples: 5012998001

Parameter	Units	Blank Result	Reporting Limit	Qualifiers
cis-1,2-Dichloroethene	ug/kg	ND	5.0	
Trichloroethene	ug/kg	ND	5.0	
Vinyl chloride	ug/kg	ND	5.0	
4-Bromofluorobenzene (S)	%	97	61-131	
Dibromofluoromethane (S)	%	100	80-124	
Toluene-d8 (S)	%	100	58-145	

LABORATORY CONTROL SAMPLE: 145028

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
cis-1,2-Dichloroethene	ug/kg	50	61.9	124	71-126	
Trichloroethene	ug/kg	50	59.2	118	74-121	
Vinyl chloride	ug/kg	50	43.3	87	50-146	
4-Bromofluorobenzene (S)	%			98	61-131	
Dibromofluoromethane (S)	%			99	80-124	
Toluene-d8 (S)	%			101	58-145	

Pace Analytical Services, Inc.
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(317)875-5894

QUALIFIERS

Project: Valhi
Pace Project No.: 5012998

DEFINITIONS

DF - Dilution Factor, if reported, represents the factor applied to the reported data due to changes in sample preparation, dilution of the sample aliquot, or moisture content.

ND - Not Detected at or above adjusted reporting limit.

J - Estimated concentration above the adjusted method detection limit and below the adjusted reporting limit.

MDL - Adjusted Method Detection Limit.

S - Surrogate

1,2-Diphenylhydrazine (8270 listed analyte) decomposes to Azobenzene.

Consistent with EPA guidelines, unrounded data are displayed and have been used to calculate % recovery and RPD values.

LCS(D) - Laboratory Control Sample (Duplicate)

MS(D) - Matrix Spike (Duplicate)

DUP - Sample Duplicate

RPD - Relative Percent Difference

NC - Not Calculable.

Pace Analytical is NELAP accredited. Contact your Pace PM for the current list of accredited analytes.

ANALYTE QUALIFIERS

R2	RPD value was outside control limits due to matrix interference
S5	Surrogate recovery outside control limits due to matrix interferences (not confirmed by re-analysis).

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

TAL-4142 (0907)

Client	Project Manager	Date	Chain of Custody Number
Arcadis	Donna	3-14-08	364153
Address	Telephone Number (Area Code)/Fax Number	Lab Number	Page 1 of 1
City / State / Zip Code	Site Contact: Jason	Lab Contact	
Project Name and Location (State)	Carrier/Waybill Number		
Contract/Purchase Order/Quote No.			

Matrix: Air, Aqueous, Sed., Soil
Containers & Preservatives: Unpres., H2SO4, HNO3, HCl, NaOH, ZnAc/NaOH

Sample I.D. No. and Description (Containers for each sample may be combined on one line)	Date	Time	Matrix	Containers & Preservatives	Analysis: TCE	Analysis: cis 1,2-DCE	Analysis: Vinyl Chloride
FD - AB23 - Post	3-14-08		Soil	Unpres.	Y	Y	Y

Analysis (Attach list if more space is needed)

SDG 12998

Special Instructions/ Conditions of Receipt

3 encore / 4 oz. jar
001

4 OK C.G WI
Temp 15.1°C
Encore Received

Possible Hazard Identification
☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal
☐ Return To Client ☐ Disposal By Lab ☐ Archive For _____ Months
(A fee may be assessed if samples are retained longer than 1 month)

Turn Around Time Required
☑ 24 Hours ☐ 48 Hours ☐ 7 Days ☐ 14 Days ☐ 21 Days ☐ Other _____

QC Requirements (Specify)

	Date	Time		Date	Time
1. Relinquished By	3-14-08	11:30am	1. Received By: Tom Libby	3/14/08	11:30a
2. Relinquished By			2. Received By: Cassandra Owens Pace	3-14-08	12:46
3. Relinquished By			3. Received By		

Comments

DISTRIBUTION: WHITE - Returned to Client with Report; CANARY - Stays with the Sample; PINK - Field Copy

Sample Condition Upon Receipt

Pace Analytical

Client Name: ARCadis Project # 5012998

Courier: ☐ Fed Ex ☐ UPS ☐ USPS ☑ Client ☐ Commercial ☐ Pace Other _____

Tracking #: _____

Custody Seal on Cooler/Box Present: ☐ yes ☑ no Seals intact: ☐ yes ☐ no

Packing Material: ☑ Bubble Wrap ☐ Bubble Bags ☐ None ☑ Other ZipLocBag

Thermometer Used 1234 Type of Ice: (Wet) Blue None ☑ Samples on ice, cooling process has begun

Cooler Temperature 15.1°C Biological Tissue is Frozen: Yes (No)

Date and Initials of person examining contents: 3-14-08 CG

Temp should be above freezing to 6°C

		Comments:
Chain of Custody Present:	☑Yes ☐No ☐N/A	1.
Chain of Custody Filled Out:	☑Yes ☐No ☐N/A	2.
Chain of Custody Relinquished:	☑Yes ☐No ☐N/A	3.
Sampler Name & Signature on COC:	☑Yes ☐No ☐N/A	4.
Samples Arrived within Hold Time:	☑Yes ☐No ☐N/A	5.
Short Hold Time Analysis (<72hr):	☐Yes ☑No ☐N/A	6.
Rush Turn Around Time Requested:	☐Yes ☑No ☐N/A	7.
Sufficient Volume:	☑Yes ☐No ☐N/A	8.
Correct Containers Used:	☑Yes ☐No ☐N/A	9.
-Pace Containers Used:	☑Yes ☐No ☐N/A	
Containers Intact:	☑Yes ☐No ☐N/A	10.
Filtered volume received for Dissolved tests	☐Yes ☐No ☑N/A	11.
Sample Labels match COC:	☑Yes ☐No ☐N/A	12.
-Includes date/time/ID/Analysis Matrix: NO		
All containers needing preservation have been checked.	☐Yes ☐No ☑N/A	13.
All containers needing preservation are found to be in compliance with EPA recommendation.	☐Yes ☐No ☐N/A	
exceptions: VOA, coliform, TOC, O&G, WI-DRO (water)	☐Yes ☑No	Initial when completed / Lot # of added preservative
Samples checked for dechlorination:	☐Yes ☐No ☑N/A	14.
Headspace in VOA Vials (>6mm):	☐Yes ☐No ☑N/A	15.
Trip Blank Present:	☐Yes ☐No ☑N/A	16.
Trip Blank Custody Seals Present	☐Yes ☐No ☑N/A	
Pace Trip Blank Lot # (if purchased): _____		

Client Notification/ Resolution: Field Data Required? Y / N

Person Contacted: _____ Date/Time: _____

Comments/ Resolution: Client was aware of temp just sampled an hour ago

Project Manager Review: _____ **Date:** 3/14/08

Note: Whenever there is a discrepancy affecting North Carolina compliance samples, a copy of this form will be sent to the North Carolina DEHNR Certification Office (i.e out of hold, incorrect preservative, out of temp, incorrect containers)

Pace Analytical Services, Inc.
7726 Moller Road
Indianapolis, IN 46268
(317)875-5894

March 31, 2008

Mr. Jason Cosgrove
Arcadis U.S., Inc.
251 E. Ohio Street
Suite 800
Indianapolis, IN 46204

RE: Project: Valhi
Pace Project No.: 5013472

Dear Mr. Cosgrove:
Enclosed are the analytical results for sample(s) received by the laboratory on March 28, 2008. The results relate only to the samples included in this report. Results reported herein conform to the most current NELAC standards, where applicable, unless otherwise narrated in the body of the report.

If you have any questions concerning this report, please feel free to contact me.

Sincerely,

Donna Spyker

dspyker@pacelabs.com
Project Manager

Illinois/NELAC Certification Number: 100418
Indiana Certification Number: C-49-06
Kansas Certification Number: E-10247
Kentucky Certification Number: 0042
Ohio VAP: CL0065
Pennsylvania: 68-00791
West Virginia Certification Number: 330

Enclosures

Pace Analytical Services, Inc.
7726 Moller Road
Indianapolis, IN 46268
(317)875-5894

SAMPLE SUMMARY

Project: Valhi
Pace Project No.: 5013472

Lab ID	Sample ID	Matrix	Date Collected	Date Received
5013472001	**AB-23-Post-2**	Solid	03/28/08 10:00	03/28/08 13:00

Pace Analytical Services, Inc.
7726 Moller Road
Indianapolis, IN 46268
(317)875-5894

SAMPLE ANALYTE COUNT

Project: Valhi
Pace Project No.: 5013472

Lab ID	Sample ID	Method	Analysts	Analytes Reported
5013472001	**AB-23-Post-2**	ASTM D2974-87	ILP	1
		EPA 8260	JLF	6

Pace Analytical Services, Inc.
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Indianapolis, IN 46268
(317)875-5894

ANALYTICAL RESULTS

Project: Valhi
Pace Project No.: 5013472

Sample: AB-23-Post-2 **Lab ID: 5013472001** Collected: 03/28/08 10:00 Received: 03/28/08 13:00 Matrix: Solid

Results reported on a "dry-weight" basis

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
8260 MSV 5035A VOA	Analytical Method: EPA 8260							
cis-1,2-Dichloroethene	ND	ug/kg	6.3	1		03/28/08 14:34	156-59-2	
Trichloroethene	**70.0**	ug/kg	6.3	1		03/28/08 14:34	79-01-6	
Vinyl chloride	ND	ug/kg	6.3	1		03/28/08 14:34	75-01-4	
Dibromofluoromethane (S)	18	%	80-124	1		03/28/08 14:34	1868-53-7	S2
Toluene-d8 (S)	107	%	58-145	1		03/28/08 14:34	2037-26-5	
4-Bromofluorobenzene (S)	78	%	61-131	1		03/28/08 14:34	460-00-4	
Percent Moisture	Analytical Method: ASTM D2974-87							
Percent Moisture	**9.0**	%	0.10	1		03/28/08 14:38		

Pace Analytical Services, Inc.
7726 Moller Road
Indianapolis, IN 46268
(317)875-5894

QUALITY CONTROL DATA

Project: Valhi
Pace Project No.: 5013472

QC Batch: MSV/8238
QC Batch Method: EPA 8260
Analysis Method: EPA 8260
Analysis Description: 8260 MSV 5035A Volatile Organics
Associated Lab Samples: 5013472001

METHOD BLANK: 148205
Associated Lab Samples: 5013472001

Parameter	Units	Blank Result	Reporting Limit	Qualifiers
cis-1,2-Dichloroethene	ug/kg	ND	5.0	
Trichloroethene	ug/kg	ND	5.0	
Vinyl chloride	ug/kg	ND	5.0	
4-Bromofluorobenzene (S)	%	84	61-131	
Dibromofluoromethane (S)	%	96	80-124	
Toluene-d8 (S)	%	101	58-145	

LABORATORY CONTROL SAMPLE: 148206

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
cis-1,2-Dichloroethene	ug/kg	50	55.6	111	76-119	
Trichloroethene	ug/kg	50	56.2	112	74-121	
Vinyl chloride	ug/kg	50	53.0	106	50-146	
4-Bromofluorobenzene (S)	%			88	61-131	
Dibromofluoromethane (S)	%			102	80-124	
Toluene-d8 (S)	%			106	58-145	

Pace Analytical Services, Inc.
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Indianapolis, IN 46268
(317)875-5894

QUALITY CONTROL DATA

Project: Valhi
Pace Project No.: 5013472

QC Batch: PMST/2377
QC Batch Method: ASTM D2974-87
Analysis Method: ASTM D2974-87
Analysis Description: Dry Weight/Percent Moisture
Associated Lab Samples: 5013472001

SAMPLE DUPLICATE: 148211

Parameter	Units	5013472001 Result	Dup Result	RPD	Max RPD	Qualifiers
Percent Moisture	%	9.0	8.8	2	5	

Pace Analytical Services, Inc.
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Indianapolis, IN 46268
(317)875-5894

QUALIFIERS

Project: Valhi
Pace Project No.: 5013472

DEFINITIONS

DF - Dilution Factor, if reported, represents the factor applied to the reported data due to changes in sample preparation, dilution of the sample aliquot, or moisture content.

ND - Not Detected at or above adjusted reporting limit.

J - Estimated concentration above the adjusted method detection limit and below the adjusted reporting limit.

MDL - Adjusted Method Detection Limit.

S - Surrogate

1,2-Diphenylhydrazine (8270 listed analyte) decomposes to Azobenzene.

Consistent with EPA guidelines, unrounded data are displayed and have been used to calculate % recovery and RPD values.

LCS(D) - Laboratory Control Sample (Duplicate)

MS(D) - Matrix Spike (Duplicate)

DUP - Sample Duplicate

RPD - Relative Percent Difference

NC - Not Calculable.

Pace Analytical is NELAP accredited. Contact your Pace PM for the current list of accredited analytes.

ANALYTE QUALIFIERS

S2	Surrogate recovery outside laboratory control limits due to matrix interferences (confirmed by similar results from sample re-analysis).

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

TAL-4142 (0907)

Client	Project Manager	Date	Chain of Custody Number
Arcadis	Jason Cosgrove		364155
Address	**Telephone Number (Area Code)/Fax Number**	**Lab Number**	**Page** _____ **of** _____
City / **State** / **Zip Code**	**Site Contact**	**Lab Contact** Donna Spyker	
Project Name and Location (State)	**Carrier/Waybill Number**		
Contract/Purchase Order/Quote No.			

Sample I.D. No. and Description (Containers for each sample may be combined on one line)	Date	Time	Matrix: Air	Aqueous	Sed.	Soil	Containers & Preservatives: Unpres.	H_2SO_4	HNO_3	HCl	NaOH	ZnAc/NaOH	Analysis: TCE	cis 1,2-DCE	Vinyl Chloride	Special Instructions/ Conditions of Receipt
AB-23-Post-[redacted]-2	3-28-08	10:00				X							X	X	X	3 encore / 4 oz. jar 001

601372

Possible Hazard Identification	Sample Disposal	(A fee may be assessed if samples are retained longer than 1 month)
☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown	☐ Return To Client ☐ Disposal By Lab ☐ Archive For _____ Months	

Turn Around Time Required
☐ 24 Hours ☐ 48 Hours ☐ 7 Days ☐ 14 Days ☐ 21 Days ☒ Other Same day Rush

QC Requirements (Specify)

	Date	Time		Date	Time
1. Relinquished By: Jason McCord, Entact, GrapeVine Services TX	3-28-08	11:42	1. Received By: Elayna Stover (American Environmental)	3-28-08	11:43am
2. Relinquished By: Elayna Stover	3-28-08	1:00p	2. Received By: Lori Childspace	3-28-08	1:00p
3. Relinquished By:			3. Received By:		

Comments

Hold WI Client

DISTRIBUTION: WHITE - Returned to Client with Report; CANARY - Stays with the Sample; PINK - Field Copy

Sample Condition Upon Receipt

Pace Analytical

Client Name: Arcadis Project # 5013472

Courier: ☐ Fed Ex ☐ UPS ☐ USPS ☒ Client ☐ Commercial ☐ Pace Other _____

Tracking #: _____

Custody Seal on Cooler/Box Present: ☐ yes ☒ no Seals intact: ☐ yes ☒ no

Packing Material: ☐ Bubble Wrap ☐ Bubble Bags ☒ None ☐ Other _____

Thermometer Used 1234

Type of Ice: (Wet) Blue None ☐ Samples on ice, cooling process has begun

Cooler Temperature 3.1°C

Biological Tissue is Frozen: Yes No

Date and Initials of person examining contents: 5/28/08

Temp should be above freezing to 6°C

Comments:

Chain of Custody Present:	☒Yes ☐No ☐N/A	1.
Chain of Custody Filled Out:	☒Yes ☐No ☐N/A	2.
Chain of Custody Relinquished:	☒Yes ☐No ☐N/A	3.
Sampler Name & Signature on COC:	☒Yes ☐No ☐N/A	4.
Samples Arrived within Hold Time:	☒Yes ☐No ☐N/A	5.
Short Hold Time Analysis (<72hr):	☐Yes ☒No ☐N/A	6. Encores - gave copy to Paula (LC)
Rush Turn Around Time Requested:	☐Yes ☒No ☐N/A	7.
Sufficient Volume:	☒Yes ☐No ☐N/A	8.
Correct Containers Used:	☒Yes ☐No ☐N/A	9.
-Pace Containers Used:	☒Yes ☐No ☐N/A	
Containers Intact:	☒Yes ☐No ☐N/A	10.
Filtered volume received for Dissolved tests	☐Yes ☐No ☐N/A	11.
Sample Labels match COC:	☒Yes ☐No ☐N/A	12.
-Includes date/time/ID/Analysis Matrix: Encore		
All containers needing preservation have been checked.	☐Yes ☐No ☒N/A	13.
All containers needing preservation are found to be in compliance with EPA recommendation.	☐Yes ☐No ☒N/A	
exceptions: VOA, coliform, TOC, O&G, WI-DRO (water)	☐Yes ☐No	Initial when completed / Lot # of added preservative
Samples checked for dechlorination:	☐Yes ☐No ☒N/A	14.
Headspace in VOA Vials (>6mm):	☐Yes ☐No ☒N/A	15.
Trip Blank Present:	☐Yes ☐No ☒N/A	16.
Trip Blank Custody Seals Present	☐Yes ☐No ☒N/A	
Pace Trip Blank Lot # (if purchased): _____		

Client Notification/ Resolution: Field Data Required? Y / N

Person Contacted: _____ Date/Time: _____

Comments/ Resolution: _____

Project Manager Review: _____ **Date:** 5/28/08

Note: Whenever there is a discrepancy affecting North Carolina compliance samples, a copy of this form will be sent to the North Carolina DEHNR Certification Office (i.e out of hold, incorrect preservative, out of temp, incorrect containers)

Pace Analytical Services, Inc.
7726 Moller Road
Indianapolis, IN 46268
(317)875-5894

April 30, 2008

Mr. Jason Cosgrove
Arcadis U.S., Inc.
251 E. Ohio Street
Suite 800
Indianapolis, IN 46204

RE: Project: Valhi
Pace Project No.: 5014193

Dear Mr. Cosgrove:
Enclosed are the analytical results for sample(s) received by the laboratory on April 22, 2008. The results relate only to the samples included in this report. Results reported herein conform to the most current NELAC standards, where applicable, unless otherwise narrated in the body of the report.

If you have any questions concerning this report, please feel free to contact me.

Sincerely,

Kelly M Jones

Kelly Jones for
Donna Spyker
donna.spyker@pacelabs.com
Project Manager

Illinois/NELAC Certification Number: 100418
Indiana Certification Number: C-49-06
Kansas Certification Number: E-10247
Kentucky Certification Number: 0042
Ohio VAP: CL0065
Pennsylvania: 68-00791
West Virginia Certification Number: 330

Enclosures

Pace Analytical Services, Inc.
7726 Moller Road
Indianapolis, IN 46268
(317)875-5894

SAMPLE SUMMARY

Project: Valhi
Pace Project No.: 5014193

Lab ID	Sample ID	Matrix	Date Collected	Date Received
5014193001	**Comp-8**	Solid	04/18/08 14:30	04/22/08 14:16
5014193002	**Comp-8 SPLP**	Water	04/18/08 14:30	04/22/08 14:16

Pace Analytical Services, Inc.
7726 Moller Road
Indianapolis, IN 46268
(317)875-5894

SAMPLE ANALYTE COUNT

Project: Valhi
Pace Project No.: 5014193

Lab ID	Sample ID	Method	Analysts	Analytes Reported
5014193001	**Comp-8**	EPA 9045	TPD	1
5014193002	**Comp-8 SPLP**	EPA 150.1	TPD	1
		EPA 8260	JLF	73

Pace Analytical Services, Inc.
7726 Moller Road
Indianapolis, IN 46268
(317)875-5894

ANALYTICAL RESULTS

Project: Valhi
Pace Project No.: 5014193

Sample: Comp-8 **Lab ID: 5014193001** Collected: 04/18/08 14:30 Received: 04/22/08 14:16 Matrix: Solid

Results reported on a "dry-weight" basis

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
9045 pH Soil	Analytical Method: EPA 9045							
pH at 25 Degrees C	**7.9**	Std. Units		1		04/28/08 09:06		

Pace Analytical Services, Inc.
7726 Moller Road
Indianapolis, IN 46268
(317)875-5894

ANALYTICAL RESULTS

Project: Valhi
Pace Project No.: 5014193

Sample: Comp-8 SPLP **Lab ID: 5014193002** Collected: 04/18/08 14:30 Received: 04/22/08 14:16 Matrix: Water

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
8260 MSV	Analytical Method: EPA 8260							
Acetone	ND	ug/L	100	1		04/25/08 15:20	67-64-1	
Acrolein	ND	ug/L	100	1		04/25/08 15:20	107-02-8	
Acrylonitrile	ND	ug/L	100	1		04/25/08 15:20	107-13-1	
Benzene	ND	ug/L	5.0	1		04/25/08 15:20	71-43-2	
Bromobenzene	ND	ug/L	5.0	1		04/25/08 15:20	108-86-1	
Bromochloromethane	ND	ug/L	5.0	1		04/25/08 15:20	74-97-5	
Bromodichloromethane	ND	ug/L	5.0	1		04/25/08 15:20	75-27-4	
Bromoform	ND	ug/L	5.0	1		04/25/08 15:20	75-25-2	
Bromomethane	ND	ug/L	5.0	1		04/25/08 15:20	74-83-9	
2-Butanone (MEK)	ND	ug/L	25.0	1		04/25/08 15:20	78-93-3	
n-Butylbenzene	ND	ug/L	5.0	1		04/25/08 15:20	104-51-8	
sec-Butylbenzene	ND	ug/L	5.0	1		04/25/08 15:20	135-98-8	
tert-Butylbenzene	ND	ug/L	5.0	1		04/25/08 15:20	98-06-6	
Carbon disulfide	ND	ug/L	10.0	1		04/25/08 15:20	75-15-0	
Carbon tetrachloride	ND	ug/L	5.0	1		04/25/08 15:20	56-23-5	
Chlorobenzene	ND	ug/L	5.0	1		04/25/08 15:20	108-90-7	
Chloroethane	ND	ug/L	5.0	1		04/25/08 15:20	75-00-3	
Chloroform	ND	ug/L	5.0	1		04/25/08 15:20	67-66-3	
Chloromethane	ND	ug/L	5.0	1		04/25/08 15:20	74-87-3	
2-Chlorotoluene	ND	ug/L	5.0	1		04/25/08 15:20	95-49-8	
4-Chlorotoluene	ND	ug/L	5.0	1		04/25/08 15:20	106-43-4	
Dibromochloromethane	ND	ug/L	5.0	1		04/25/08 15:20	124-48-1	
1,2-Dibromoethane (EDB)	ND	ug/L	5.0	1		04/25/08 15:20	106-93-4	
Dibromomethane	ND	ug/L	5.0	1		04/25/08 15:20	74-95-3	
1,2-Dichlorobenzene	ND	ug/L	5.0	1		04/25/08 15:20	95-50-1	
1,3-Dichlorobenzene	ND	ug/L	5.0	1		04/25/08 15:20	541-73-1	
1,4-Dichlorobenzene	ND	ug/L	5.0	1		04/25/08 15:20	106-46-7	
trans-1,4-Dichloro-2-butene	ND	ug/L	100	1		04/25/08 15:20	110-57-6	
Dichlorodifluoromethane	ND	ug/L	5.0	1		04/25/08 15:20	75-71-8	
1,1-Dichloroethane	ND	ug/L	5.0	1		04/25/08 15:20	75-34-3	
1,2-Dichloroethane	ND	ug/L	5.0	1		04/25/08 15:20	107-06-2	
1,1-Dichloroethene	ND	ug/L	5.0	1		04/25/08 15:20	75-35-4	
cis-1,2-Dichloroethene	ND	ug/L	5.0	1		04/25/08 15:20	156-59-2	
trans-1,2-Dichloroethene	ND	ug/L	5.0	1		04/25/08 15:20	156-60-5	
1,2-Dichloropropane	ND	ug/L	5.0	1		04/25/08 15:20	78-87-5	
1,3-Dichloropropane	ND	ug/L	5.0	1		04/25/08 15:20	142-28-9	
2,2-Dichloropropane	ND	ug/L	5.0	1		04/25/08 15:20	594-20-7	
1,1-Dichloropropene	ND	ug/L	5.0	1		04/25/08 15:20	563-58-6	
cis-1,3-Dichloropropene	ND	ug/L	5.0	1		04/25/08 15:20	10061-01-5	
trans-1,3-Dichloropropene	ND	ug/L	5.0	1		04/25/08 15:20	10061-02-6	
Ethylbenzene	ND	ug/L	5.0	1		04/25/08 15:20	100-41-4	
Ethyl methacrylate	ND	ug/L	100	1		04/25/08 15:20	97-63-2	
Hexachloro-1,3-butadiene	ND	ug/L	5.0	1		04/25/08 15:20	87-68-3	
n-Hexane	ND	ug/L	5.0	1		04/25/08 15:20	110-54-3	
2-Hexanone	ND	ug/L	25.0	1		04/25/08 15:20	591-78-6	
Iodomethane	ND	ug/L	10.0	1		04/25/08 15:20	74-88-4	
Isopropylbenzene (Cumene)	ND	ug/L	5.0	1		04/25/08 15:20	98-82-8	

Pace Analytical Services, Inc.
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ANALYTICAL RESULTS

Project: Valhi
Pace Project No.: 5014193

Sample: Comp-8 SPLP **Lab ID: 5014193002** Collected: 04/18/08 14:30 Received: 04/22/08 14:16 Matrix: Water

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
8260 MSV	Analytical Method: EPA 8260							
p-Isopropyltoluene	ND	ug/L	5.0	1		04/25/08 15:20	99-87-6	
Methylene chloride	ND	ug/L	5.0	1		04/25/08 15:20	75-09-2	
4-Methyl-2-pentanone (MIBK)	ND	ug/L	25.0	1		04/25/08 15:20	108-10-1	
Methyl-tert-butyl ether	ND	ug/L	4.0	1		04/25/08 15:20	1634-04-4	
Naphthalene	ND	ug/L	5.0	1		04/25/08 15:20	91-20-3	
n-Propylbenzene	ND	ug/L	5.0	1		04/25/08 15:20	103-65-1	
Styrene	ND	ug/L	5.0	1		04/25/08 15:20	100-42-5	
1,1,1,2-Tetrachloroethane	ND	ug/L	5.0	1		04/25/08 15:20	630-20-6	
1,1,2,2-Tetrachloroethane	ND	ug/L	5.0	1		04/25/08 15:20	79-34-5	
Tetrachloroethene	ND	ug/L	5.0	1		04/25/08 15:20	127-18-4	
Toluene	ND	ug/L	5.0	1		04/25/08 15:20	108-88-3	
1,2,3-Trichlorobenzene	ND	ug/L	5.0	1		04/25/08 15:20	87-61-6	
1,2,4-Trichlorobenzene	ND	ug/L	5.0	1		04/25/08 15:20	120-82-1	
1,1,1-Trichloroethane	ND	ug/L	5.0	1		04/25/08 15:20	71-55-6	
1,1,2-Trichloroethane	ND	ug/L	5.0	1		04/25/08 15:20	79-00-5	
Trichloroethene	**22.8**	ug/L	5.0	1		04/25/08 15:20	79-01-6	
Trichlorofluoromethane	ND	ug/L	5.0	1		04/25/08 15:20	75-69-4	
1,2,3-Trichloropropane	ND	ug/L	5.0	1		04/25/08 15:20	96-18-4	
1,2,4-Trimethylbenzene	ND	ug/L	5.0	1		04/25/08 15:20	95-63-6	
1,3,5-Trimethylbenzene	ND	ug/L	5.0	1		04/25/08 15:20	108-67-8	
Vinyl acetate	ND	ug/L	10.0	1		04/25/08 15:20	108-05-4	
Vinyl chloride	ND	ug/L	2.0	1		04/25/08 15:20	75-01-4	
Xylene (Total)	ND	ug/L	10.0	1		04/25/08 15:20	1330-20-7	
Dibromofluoromethane (S)	32	%	80-123	1		04/25/08 15:20	1868-53-7	S2
4-Bromofluorobenzene (S)	101	%	70-126	1		04/25/08 15:20	460-00-4	
Toluene-d8 (S)	101	%	80-116	1		04/25/08 15:20	2037-26-5	
150.1 pH	Analytical Method: EPA 150.1							
pH	**7.6**	Std. Units		1		04/25/08 10:12		

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QUALITY CONTROL DATA

Project: Valhi
Pace Project No.: 5014193

QC Batch: WET/3017
QC Batch Method: EPA 150.1
Analysis Method: EPA 150.1
Analysis Description: 150.1 pH
Associated Lab Samples: 5014193002

SAMPLE DUPLICATE: 157226

Parameter	Units	5014283001 Result	Dup Result	RPD	Max RPD	Qualifiers
pH	Std. Units	6.9	6.8	0	20	

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QUALITY CONTROL DATA

Project: Valhi
Pace Project No.: 5014193

QC Batch: WET/3019
QC Batch Method: EPA 9045
Analysis Method: EPA 9045
Analysis Description: 9045 pH
Associated Lab Samples: 5014193001

SAMPLE DUPLICATE: 157284

Parameter	Units	5014224001 Result	Dup Result	RPD	Max RPD	Qualifiers
pH at 25 Degrees C	Std. Units	7.8	7.7	1		

SAMPLE DUPLICATE: 157285

Parameter	Units	5014224015 Result	Dup Result	RPD	Max RPD	Qualifiers
pH at 25 Degrees C	Std. Units	7.6	7.5	1		

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QUALITY CONTROL DATA

Project: Valhi
Pace Project No.: 5014193

QC Batch: MSV/8748
QC Batch Method: EPA 8260
Analysis Method: EPA 8260
Analysis Description: 8260 MSV
Associated Lab Samples: 5014193002

METHOD BLANK: 158031
Associated Lab Samples: 5014193002

Parameter	Units	Blank Result	Reporting Limit	Qualifiers
1,1,1,2-Tetrachloroethane	ug/L	ND	5.0	
1,1,1-Trichloroethane	ug/L	ND	5.0	
1,1,2,2-Tetrachloroethane	ug/L	ND	5.0	
1,1,2-Trichloroethane	ug/L	ND	5.0	
1,1-Dichloroethane	ug/L	ND	5.0	
1,1-Dichloroethene	ug/L	ND	5.0	
1,1-Dichloropropene	ug/L	ND	5.0	
1,2,3-Trichlorobenzene	ug/L	ND	5.0	
1,2,3-Trichloropropane	ug/L	ND	5.0	
1,2,4-Trichlorobenzene	ug/L	ND	5.0	
1,2,4-Trimethylbenzene	ug/L	ND	5.0	
1,2-Dibromoethane (EDB)	ug/L	ND	5.0	
1,2-Dichlorobenzene	ug/L	ND	5.0	
1,2-Dichloroethane	ug/L	ND	5.0	
1,2-Dichloropropane	ug/L	ND	5.0	
1,3,5-Trimethylbenzene	ug/L	ND	5.0	
1,3-Dichlorobenzene	ug/L	ND	5.0	
1,3-Dichloropropane	ug/L	ND	5.0	
1,4-Dichlorobenzene	ug/L	ND	5.0	
2,2-Dichloropropane	ug/L	ND	5.0	
2-Butanone (MEK)	ug/L	ND	25.0	
2-Chlorotoluene	ug/L	ND	5.0	
2-Hexanone	ug/L	ND	25.0	
4-Chlorotoluene	ug/L	ND	5.0	
4-Methyl-2-pentanone (MIBK)	ug/L	ND	25.0	
Acetone	ug/L	ND	100	
Acrolein	ug/L	ND	100	
Acrylonitrile	ug/L	ND	100	
Benzene	ug/L	ND	5.0	
Bromobenzene	ug/L	ND	5.0	
Bromochloromethane	ug/L	ND	5.0	
Bromodichloromethane	ug/L	ND	5.0	
Bromoform	ug/L	ND	5.0	
Bromomethane	ug/L	ND	5.0	
Carbon disulfide	ug/L	ND	10.0	
Carbon tetrachloride	ug/L	ND	5.0	
Chlorobenzene	ug/L	ND	5.0	
Chloroethane	ug/L	ND	5.0	
Chloroform	ug/L	ND	5.0	
Chloromethane	ug/L	ND	5.0	
cis-1,2-Dichloroethene	ug/L	ND	5.0	
cis-1,3-Dichloropropene	ug/L	ND	5.0	
Dibromochloromethane	ug/L	ND	5.0	

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QUALITY CONTROL DATA

Project: Valhi
Pace Project No.: 5014193

METHOD BLANK: 158031

Associated Lab Samples: 5014193002

Parameter	Units	Blank Result	Reporting Limit	Qualifiers
Dibromomethane	ug/L	ND	5.0	
Dichlorodifluoromethane	ug/L	ND	5.0	
Ethyl methacrylate	ug/L	ND	100	
Ethylbenzene	ug/L	ND	5.0	
Hexachloro-1,3-butadiene	ug/L	ND	5.0	
Iodomethane	ug/L	ND	10.0	
Isopropylbenzene (Cumene)	ug/L	ND	5.0	
Methyl-tert-butyl ether	ug/L	ND	4.0	
Methylene chloride	ug/L	ND	5.0	
n-Butylbenzene	ug/L	ND	5.0	
n-Hexane	ug/L	ND	5.0	
n-Propylbenzene	ug/L	ND	5.0	
Naphthalene	ug/L	ND	5.0	
p-Isopropyltoluene	ug/L	ND	5.0	
sec-Butylbenzene	ug/L	ND	5.0	
Styrene	ug/L	ND	5.0	
tert-Butylbenzene	ug/L	ND	5.0	
Tetrachloroethene	ug/L	ND	5.0	
Toluene	ug/L	ND	5.0	
trans-1,2-Dichloroethene	ug/L	ND	5.0	
trans-1,3-Dichloropropene	ug/L	ND	5.0	
trans-1,4-Dichloro-2-butene	ug/L	ND	100	
Trichloroethene	ug/L	ND	5.0	
Trichlorofluoromethane	ug/L	ND	5.0	
Vinyl acetate	ug/L	ND	10.0	
Vinyl chloride	ug/L	ND	2.0	
Xylene (Total)	ug/L	ND	10.0	
4-Bromofluorobenzene (S)	%	98	70-126	
Dibromofluoromethane (S)	%	93	80-123	
Toluene-d8 (S)	%	98	80-116	

LABORATORY CONTROL SAMPLE: 158032

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
1,1,1,2-Tetrachloroethane	ug/L	50	41.9	84	69-130	
1,1,1-Trichloroethane	ug/L	50	41.0	82	69-136	
1,1,2,2-Tetrachloroethane	ug/L	50	44.7	89	69-131	
1,1,2-Trichloroethane	ug/L	50	45.2	90	77-132	
1,1-Dichloroethane	ug/L	50	42.0	84	67-133	
1,1-Dichloroethene	ug/L	50	47.1	94	63-128	
1,1-Dichloropropene	ug/L	50	45.7	91	75-134	
1,2,3-Trichlorobenzene	ug/L	50	45.7	91	58-131	
1,2,3-Trichloropropane	ug/L	50	43.8	88	60-131	
1,2,4-Trichlorobenzene	ug/L	50	49.4	99	60-130	
1,2,4-Trimethylbenzene	ug/L	50	49.2	98	73-130	

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QUALITY CONTROL DATA

Project: Valhi
Pace Project No.: 5014193

LABORATORY CONTROL SAMPLE: 158032

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
1,2-Dibromoethane (EDB)	ug/L	50	41.8	84	75-126	
1,2-Dichlorobenzene	ug/L	50	43.8	88	76-124	
1,2-Dichloroethane	ug/L	50	39.6	79	69-139	
1,2-Dichloropropane	ug/L	50	43.0	86	76-129	
1,3,5-Trimethylbenzene	ug/L	50	48.6	97	74-130	
1,3-Dichlorobenzene	ug/L	50	46.1	92	76-125	
1,3-Dichloropropane	ug/L	50	44.4	89	74-126	
1,4-Dichlorobenzene	ug/L	50	44.0	88	75-122	
2,2-Dichloropropane	ug/L	50	47.2	94	53-144	
2-Butanone (MEK)	ug/L	250	356	143	47-189	
2-Chlorotoluene	ug/L	50	45.4	91	72-128	
2-Hexanone	ug/L	250	338	135	57-167	
4-Chlorotoluene	ug/L	50	45.9	92	73-124	
4-Methyl-2-pentanone (MIBK)	ug/L	250	240	96	61-135	
Acetone	ug/L	250	567	227	30-170	L0
Acrolein	ug/L	1000	2560	256	30-170	L3
Acrylonitrile	ug/L	1000	864	86	67-136	
Benzene	ug/L	50	44.0	88	78-127	
Bromobenzene	ug/L	50	43.1	86	62-139	
Bromochloromethane	ug/L	50	54.2	108	54-162	
Bromodichloromethane	ug/L	50	39.3	79	69-133	
Bromoform	ug/L	50	42.3	85	60-127	
Bromomethane	ug/L	50	65.9	132	30-170	
Carbon disulfide	ug/L	100	90.7	91	58-152	
Carbon tetrachloride	ug/L	50	44.9	90	62-143	
Chlorobenzene	ug/L	50	43.0	86	75-123	
Chloroethane	ug/L	50	51.6	103	56-153	
Chloroform	ug/L	50	40.3	81	74-131	
Chloromethane	ug/L	50	53.5	107	35-147	
cis-1,2-Dichloroethene	ug/L	50	44.6	89	74-128	
cis-1,3-Dichloropropene	ug/L	50	42.2	84	58-123	
Dibromochloromethane	ug/L	50	41.9	84	66-131	
Dibromomethane	ug/L	50	44.0	88	73-133	
Dichlorodifluoromethane	ug/L	50	48.9	98	30-170	
Ethyl methacrylate	ug/L	50	ND	84	59-138	
Ethylbenzene	ug/L	50	45.5	91	81-126	
Hexachloro-1,3-butadiene	ug/L	50	44.5	89	70-130	
Iodomethane	ug/L	100	187	187	41-170	L3
Isopropylbenzene (Cumene)	ug/L	50	48.6	97	80-130	
Methyl-tert-butyl ether	ug/L	100	89.5	89	66-147	
Methylene chloride	ug/L	50	46.9	94	32-164	
n-Butylbenzene	ug/L	50	49.7	99	68-135	
n-Hexane	ug/L	50	46.6	93	69-157	
n-Propylbenzene	ug/L	50	50.5	101	71-132	
Naphthalene	ug/L	50	38.8	78	61-135	
p-Isopropyltoluene	ug/L	50	48.8	98	66-131	
sec-Butylbenzene	ug/L	50	50.7	101	73-130	
Styrene	ug/L	50	45.8	92	74-128	

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QUALITY CONTROL DATA

Project: Valhi
Pace Project No.: 5014193

LABORATORY CONTROL SAMPLE: 158032

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
tert-Butylbenzene	ug/L	50	44.2	88	63-117	
Tetrachloroethene	ug/L	50	41.7	83	60-119	
Toluene	ug/L	50	45.1	90	75-129	
trans-1,2-Dichloroethene	ug/L	50	44.9	90	71-126	
trans-1,3-Dichloropropene	ug/L	50	40.6	81	54-123	
trans-1,4-Dichloro-2-butene	ug/L	50	42.1J	84	47-141	
Trichloroethene	ug/L	50	42.0	84	74-130	
Trichlorofluoromethane	ug/L	50	47.8	96	62-150	
Vinyl acetate	ug/L	200	147	73	41-145	
Vinyl chloride	ug/L	50	51.2	102	55-141	
Xylene (Total)	ug/L	150	140	94	76-132	
4-Bromofluorobenzene (S)	%			97	70-126	
Dibromofluoromethane (S)	%			94	80-123	
Toluene-d8 (S)	%			103	80-116	

MATRIX SPIKE SAMPLE: 158033

Parameter	Units	5014193002 Result	Spike Conc.	MS Result	MS % Rec	% Rec Limits	Qualifiers
1,1,1,2-Tetrachloroethane	ug/L	ND	50	36.8	74	55-131	
1,1,1-Trichloroethane	ug/L	ND	50	43.5	87	64-143	
1,1,2,2-Tetrachloroethane	ug/L	ND	50	.92J	2	64-142	
1,1,2-Trichloroethane	ug/L	ND	50	13.8	28	71-143	
1,1-Dichloroethane	ug/L	ND	50	44.4	89	68-139	
1,1-Dichloroethene	ug/L	ND	50	76.6	153	55-140	1d
1,1-Dichloropropene	ug/L	ND	50	46.5	93	66-140	
1,2,3-Trichlorobenzene	ug/L	ND	50	45.9	89	33-140	
1,2,3-Trichloropropane	ug/L	ND	50	40.8	82	58-133	
1,2,4-Trichlorobenzene	ug/L	ND	50	45.9	90	28-140	
1,2,4-Trimethylbenzene	ug/L	ND	50	48.6	96	39-146	
1,2-Dibromoethane (EDB)	ug/L	ND	50	42.2	84	67-134	
1,2-Dichlorobenzene	ug/L	ND	50	44.2	88	48-137	
1,2-Dichloroethane	ug/L	ND	50	41.2	82	63-148	
1,2-Dichloropropane	ug/L	ND	50	44.2	88	70-136	
1,3,5-Trimethylbenzene	ug/L	ND	50	48.4	96	39-145	
1,3-Dichlorobenzene	ug/L	ND	50	45.2	90	40-143	
1,3-Dichloropropane	ug/L	ND	50	43.7	87	65-133	
1,4-Dichlorobenzene	ug/L	ND	50	42.6	85	38-142	
2,2-Dichloropropane	ug/L	ND	50	48.0	96	35-157	
2-Butanone (MEK)	ug/L	ND	250	415	166	62-132	
2-Chlorotoluene	ug/L	ND	50	45.7	91	44-143	
2-Hexanone	ug/L	ND	250	375	150	61-141	
4-Chlorotoluene	ug/L	ND	50	45.7	91	43-140	
4-Methyl-2-pentanone (MIBK)	ug/L	ND	250	248	99	57-135	
Acetone	ug/L	ND	250	683	273	30-170	
Acrolein	ug/L	ND	1000	2650	265	30-170	
Acrylonitrile	ug/L	ND	1000	860	86	66-137	
Benzene	ug/L	ND	50	45.9	92	63-141	

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QUALITY CONTROL DATA

Project: Valhi
Pace Project No.: 5014193

MATRIX SPIKE SAMPLE: 158033

Parameter	Units	5014193002 Result	Spike Conc.	MS Result	MS % Rec	% Rec Limits	Qualifiers
Bromobenzene	ug/L	ND	50	43.9	88	57-128	
Bromochloromethane	ug/L	ND	50	57.6	115	65-157	
Bromodichloromethane	ug/L	ND	50	30.2	60	63-135	
Bromoform	ug/L	ND	50	39.5	79	58-124	
Bromomethane	ug/L	ND	50	64.0	128	30-170	
Carbon disulfide	ug/L	ND	100	82.6	83	46-162	
Carbon tetrachloride	ug/L	ND	50	47.2	94	54-145	
Chlorobenzene	ug/L	ND	50	43.2	86	56-133	
Chloroethane	ug/L	ND	50	70.2	140	54-157	
Chloroform	ug/L	ND	50	42.0	84	67-134	
Chloromethane	ug/L	ND	50	65.3	131	36-137	
cis-1,2-Dichloroethene	ug/L	ND	50	47.0	93	65-132	
cis-1,3-Dichloropropene	ug/L	ND	50	40.3	81	46-121	
Dibromochloromethane	ug/L	ND	50	34.4	69	64-124	
Dibromomethane	ug/L	ND	50	46.1	92	67-144	
Dichlorodifluoromethane	ug/L	ND	50	54.4	109	30-163	
Ethyl methacrylate	ug/L	ND	50	ND	0	52-140	
Ethylbenzene	ug/L	ND	50	47.7	93	44-151	
Hexachloro-1,3-butadiene	ug/L	ND	50	44.7	88	30-145	
Iodomethane	ug/L	ND	100	150	150	28-168	
Isopropylbenzene (Cumene)	ug/L	ND	50	49.9	100	40-148	
Methyl-tert-butyl ether	ug/L	ND	100	93.1	93	52-156	
Methylene chloride	ug/L	ND	50	53.5	105	46-154	
n-Butylbenzene	ug/L	ND	50	48.6	97	27-153	
n-Hexane	ug/L	ND	50	48.0	96	32-176	
n-Propylbenzene	ug/L	ND	50	50.9	102	40-148	
Naphthalene	ug/L	ND	50	40.0	79	44-138	
p-Isopropyltoluene	ug/L	ND	50	47.8	95	34-146	
sec-Butylbenzene	ug/L	ND	50	51.1	102	38-150	
Styrene	ug/L	ND	50	46.6	93	38-141	
tert-Butylbenzene	ug/L	ND	50	45.1	90	32-133	
Tetrachloroethene	ug/L	ND	50	41.4	81	25-146	
Toluene	ug/L	ND	50	45.3	89	59-142	
trans-1,2-Dichloroethene	ug/L	ND	50	46.5	93	60-137	
trans-1,3-Dichloropropene	ug/L	ND	50	39.9	80	43-117	
trans-1,4-Dichloro-2-butene	ug/L	ND	50	40.4J	81	44-139	
Trichloroethene	ug/L	22.8	50	105	163	61-137	
Trichlorofluoromethane	ug/L	ND	50	49.8	100	53-162	
Vinyl acetate	ug/L	ND	200	28.5	14	24-132	
Vinyl chloride	ug/L	ND	50	53.2	106	51-144	
Xylene (Total)	ug/L	ND	150	150	95	44-152	
4-Bromofluorobenzene (S)	%				99	70-126	
Dibromofluoromethane (S)	%				32	80-123	S2
Toluene-d8 (S)	%				102	80-116	

Pace Analytical Services, Inc.
7726 Moller Road
Indianapolis, IN 46268
(317)875-5894

QUALIFIERS

Project: Valhi
Pace Project No.: 5014193

DEFINITIONS

DF - Dilution Factor, if reported, represents the factor applied to the reported data due to changes in sample preparation, dilution of the sample aliquot, or moisture content.

ND - Not Detected at or above adjusted reporting limit.

J - Estimated concentration above the adjusted method detection limit and below the adjusted reporting limit.

MDL - Adjusted Method Detection Limit.

S - Surrogate

1,2-Diphenylhydrazine (8270 listed analyte) decomposes to Azobenzene.

Consistent with EPA guidelines, unrounded data are displayed and have been used to calculate % recovery and RPD values.

LCS(D) - Laboratory Control Sample (Duplicate)

MS(D) - Matrix Spike (Duplicate)

DUP - Sample Duplicate

RPD - Relative Percent Difference

NC - Not Calculable.

Pace Analytical is NELAP accredited. Contact your Pace PM for the current list of accredited analytes.

SAMPLE QUALIFIERS

Sample: 5014193002

[1]	Sample was prepared by SPLP Method 1312.

ANALYTE QUALIFIERS

1d	Multiple compounds are outside acceptance limits, refer to LCS for data acceptability and system control. JLF 4/28/08.
L0	Analyte recovery in the laboratory control sample (LCS) was outside QC limits.
L3	Analyte recovery in the laboratory control sample (LCS) exceeded QC limits. Analyte presence below reporting limits in associated samples. Results unaffected by high bias.
S2	Surrogate recovery outside laboratory control limits due to matrix interferences (confirmed by similar results from sample re-analysis).

ARCADIS

Laboratory Task Order No./P.O. No. _____

CHAIN-OF-CUSTODY RECORD

Page 1 of 1

Project Number/Name Valhi

Project Location Crawfordsville, IN

Laboratory Pace

Project Manager J. Cosgrove

Sampler(s)/Affiliation MJ / ARCADIS

SD 14193

Sample ID/Location	Matrix	Date/Time Sampled	Lab ID	ANALYSIS / METHOD / SIZE: SPLP VOCs	SPLP pH	*Standard pH	NW	Remarks	Total
Comp-B	S	4/18/08/1430		X	X	X	X	001 / 002	2

Sample Matrix: L = Liquid; S = Solid; A = Air

Total No. of Bottles/ Containers: 2

					Seal Intact?
Relinquished by:	Organization: ARCADIS	Date 4/22/08	Time 2:16 P		
Received by:	Organization: Pace	Date 4/22/08	Time 2:16p		Yes No N/A
Relinquished by:	Organization:	Date / /	Time		Seal Intact?
Received by:	Organization:	Date / /	Time		Yes No N/A

Special Instructions/Remarks: WE 20 KD Client Del. T=4.8°C

Delivery Method: ☒ In Person ☐ Common Carrier _____ SPECIFY ☐ Lab Courier ☐ Other _____ SPECIFY

AG 05-12/01

Sample Condition Upon Receipt

Pace Analytical

Client Name: Arcadis Project # 6014193

Courier: ☐ Fed Ex ☐ UPS ☐ USPS ☑ Client ☐ Commercial ☐ Pace Other _____

Tracking #: _____

Custody Seal on Cooler/Box Present: ☐ yes ☑ no Seals intact: ☐ yes ☐ no

Packing Material: ☐ Bubble Wrap ☐ Bubble Bags ☐ None ☑ Other Foam

Thermometer Used 1234 **Type of Ice:** (Wet) Blue None ☐ Samples on ice, cooling process has begun

Cooler Temperature 4.8°C **Biological Tissue is Frozen:** Yes (No)

Temp should be above freezing to 6°C

Comments:

Date and Initials of person examining contents: 4/23/08

Chain of Custody Present:	☑Yes ☐No ☐N/A	1.
Chain of Custody Filled Out:	☑Yes ☐No ☐N/A	2.
Chain of Custody Relinquished:	☑Yes ☐No ☐N/A	3.
Sampler Name & Signature on COC:	☑Yes ☐No ☐N/A	4.
Samples Arrived within Hold Time:	☑Yes ☐No ☐N/A	5.
Short Hold Time Analysis (<72hr):	☐Yes ☐No ☑N/A	6.
Rush Turn Around Time Requested:	☐Yes ☐No ☑N/A	7.
Sufficient Volume:	☑Yes ☐No ☐N/A	8.
Correct Containers Used:	☑Yes ☐No ☐N/A	9.
-Pace Containers Used:	☑Yes ☐No ☐N/A	
Containers Intact:	☑Yes ☐No ☐N/A	10.
Filtered volume received for Dissolved tests	☐Yes ☐No ☑N/A	11.
Sample Labels match COC:	☑Yes ☐No ☐N/A	12.
-Includes date/time/ID/Analysis Matrix: Yes		
All containers needing preservation have been checked.	☐Yes ☐No ☑N/A	13.
All containers needing preservation are found to be in compliance with EPA recommendation.	☐Yes ☐No ☑N/A	
exceptions: VOA, coliform, TOC, O&G, WI-DRO (water)	☐Yes ☑No	Initial when completed / Lot # of added preservative
Samples checked for dechlorination:	☐Yes ☐No ☑N/A	14.
Headspace in VOA Vials (>6mm):	☐Yes ☐No ☑N/A	15.
Trip Blank Present:	☐Yes ☐No ☑N/A	16.
Trip Blank Custody Seals Present	☐Yes ☐No ☐N/A	
Pace Trip Blank Lot # (if purchased):		

Client Notification/ Resolution: Field Data Required? Y / N

Person Contacted: _____ Date/Time: _____

Comments/ Resolution: _____

Project Manager Review: _____ **Date:** 4/23/08

Note: Whenever there is a discrepancy affecting North Carolina compliance samples, a copy of this form will be sent to the North Carolina DEHNR Certification Office (i.e out of hold, incorrect preservative, out of temp, incorrect containers)

Evaluation of Quicklime Application as a Method of Treating Contaminated Soils

Presented at:

The TRB Committee on Waste Management's Environmental Stewardship in Transportation Through Waste Management, Materials Reuse and EMS Conference

July 18, 2005

UF Principal Investigators: Tim Townsend and Angela Lindner
UF Graduate Assistants: Jae Hac Ko, Aaron Jordan, and Kim Cochran
FDOT Participants: Curtis Barnes, Terry Zinn, and Louis Reis

UNIVERSITY OF FLORIDA

Motivation

- A site remediation project conducted by the Florida Department of Environmental Protection found that the addition of quicklime to the site's contaminated soils greatly reduced soil organic contaminant concentrations.
- More information was needed on what happened, why, and whether this technique might have application at other sites.

Fairbanks

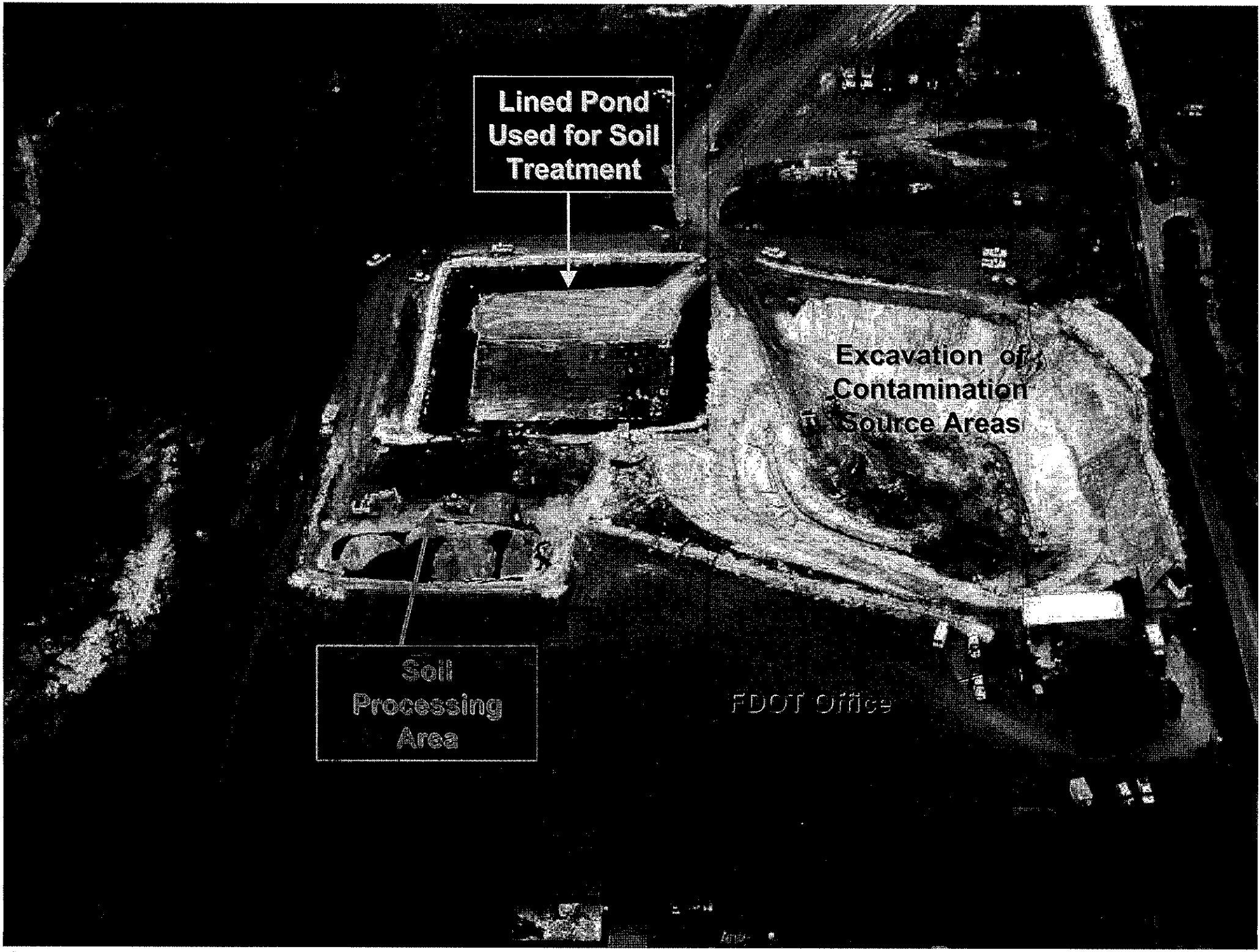
- Contaminated FDOT site in Fairbanks, Florida where the Bureau of Materials Research (BMR) laboratory conducted tests to determine if asphalt paving materials met specifications
- Solvents (including TCE) were originally used to dissolve the asphalt
- Wastes from the BMR lab were disposed on-site

Fairbanks

- After original remediation, more source contamination was found in 1998
- DNAPL was found approximately 35 feet below ground surface
- Soils were excavated, processed and stored in a lined pond for vacuum extraction

Fairbanks

- Quicklime was added to amend the soils physical properties as it became more clayey at 32 feet bgs
- Heat was generated from the exothermic reaction
- The contaminants of concern were then below limits after the reaction
- Quicklime was used to treat the rest of the contaminated soils


Lined Pond Used for Soil Treatment
Excavation of Contamination Source Areas
Soil Processing Area
FDOT Office

Possible Contaminant Reduction Mechanisms

- Volatilization
  - $CaO + H_2O \rightarrow Ca(OH)_2 + heat$
- Abiotic reaction
  - Destructive adsorption
- Encapsulation/adsorption
  - Entrapment of the contaminants in the soil-$Ca(OH)_2$ matrix

Sedlak et al., 1991

Research Objectives

- Determine the *dominant mechanism* of contaminant removal by quicklime treatment.
- Evaluate the *conditions and parameters that impact* the treatment process.
- Assess the *feasibility* of quicklime addition as a cost-effective, efficient and regulatory-permissible treatment scheme.
- Evaluate the application of the technology at *other contaminated sites*.

Applicability

- If quicklime application is found to be a feasible method of remediation, this research will provide guidance on how DOT can use it at other sites
- Including:
  - Which pollutants this treatment is effective for
  - Necessary site conditions for effectiveness
  - Amount of quicklime needed
  - Mixing procedure
  - Regulatory guidance
  - Costs

Current Activities

- Laboratory Research
  - Identify the treatment mechanism
    - Determine the amount volatilized by examining the air above the soil
    - Determine the amount treated by examining the amount of chloride left in the soil
    - Determine the amount of contaminant left in the soil
  - Perform a mass balance of the contaminants for the quicklime reaction
    - Ensure that all of the contaminant is accounted for
- Feasibility Study
  - Investigate possible regulatory restrictions

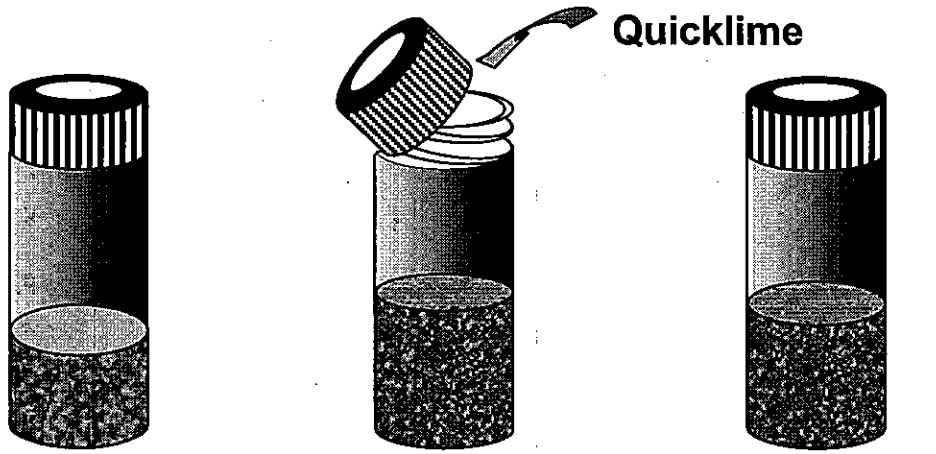
Two Laboratory Tests

- Batch tests
  - Testing the reaction of quicklime and VOCs in a closed system
  - Quick way to look at the results before and after the reaction
- Real-time tests
  - Air flows through the system
  - Allows analysis throughout the entire reaction to determine when treatment occurs

Initial Batch Experiments

- Initial Apparatus
  - 40 mL EPA VOC vials
- Media
  - 20 g sand and 1g or 2g water
- Contaminants
  - 100 .L cis-dichloroethylene (cis-DCE) or trichloroethylene (TCE)
- Analyses
  - Volatile Organic Compounds (VOCs):

    Gas Chromatography/Mass Spectrometry (GC/MS), Gas Chromatography/ Electron Capture Detector (GC/ECD)
  - Chloride ions: Ion Chromatography (IC)



Soil, water, and contaminant

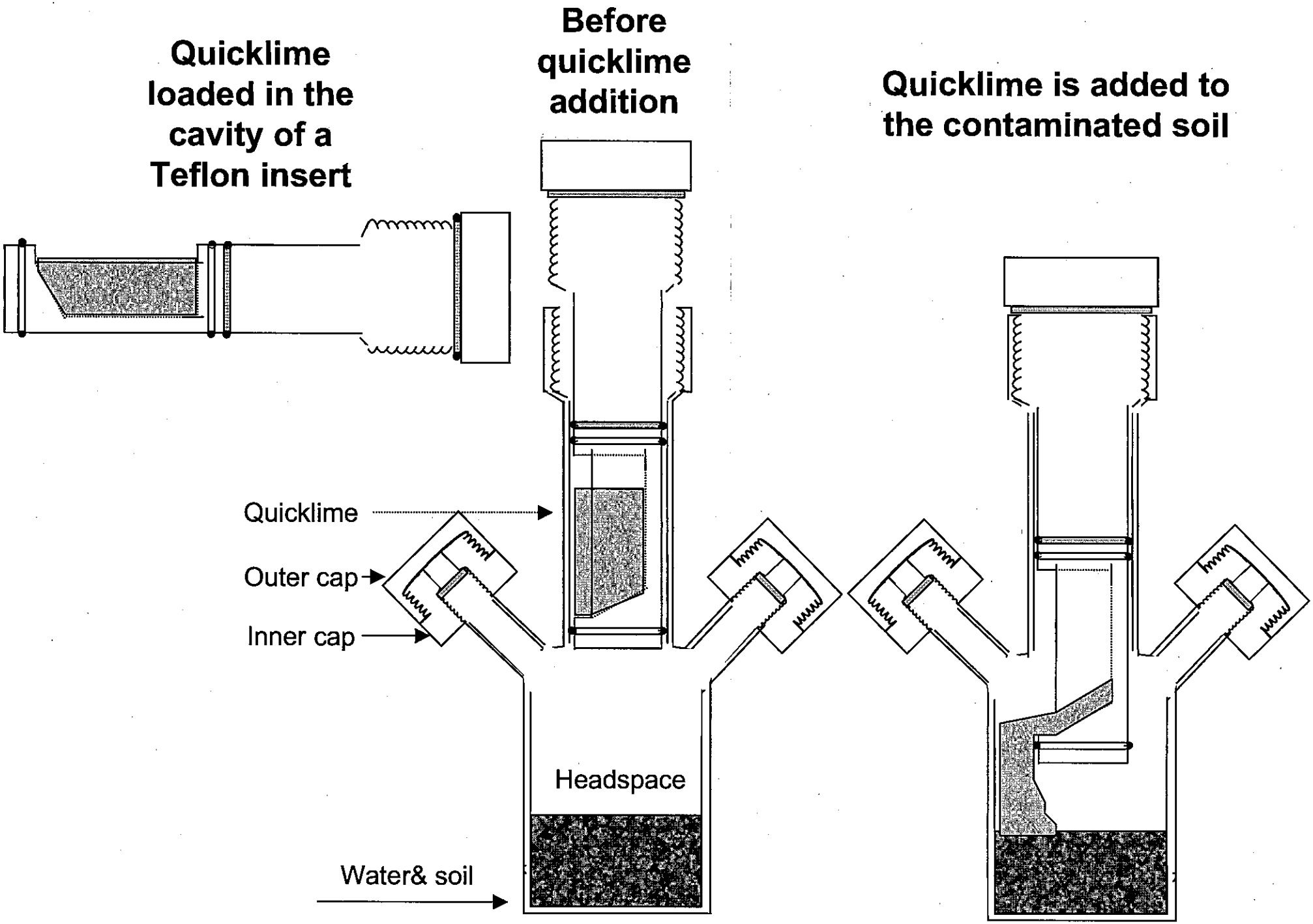
Quicklime is added

Slaking (Quicklime reacts with water)

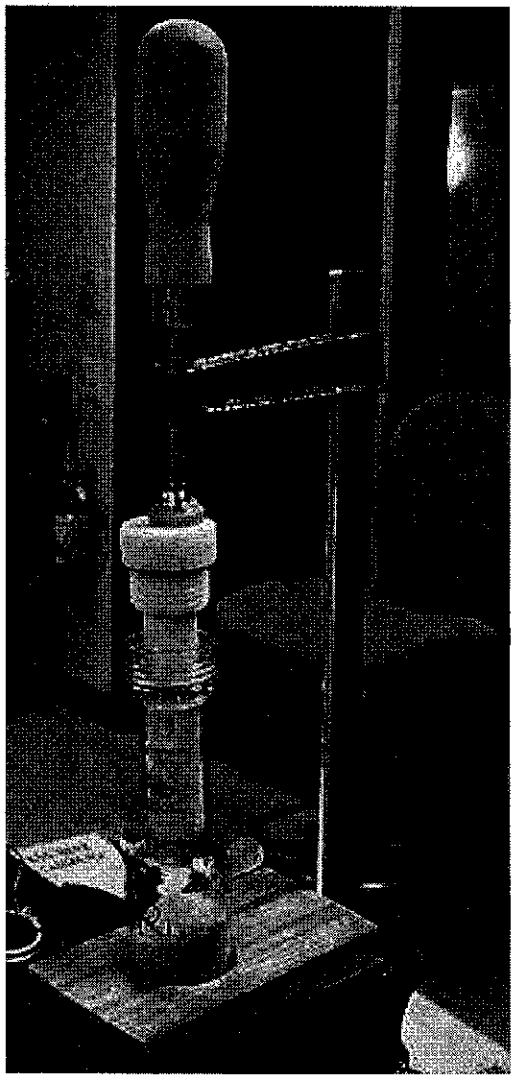
VOCs are able to escape when quicklime is added! New apparatus needed to prevent any VOC loss.

Newly Designed Vial

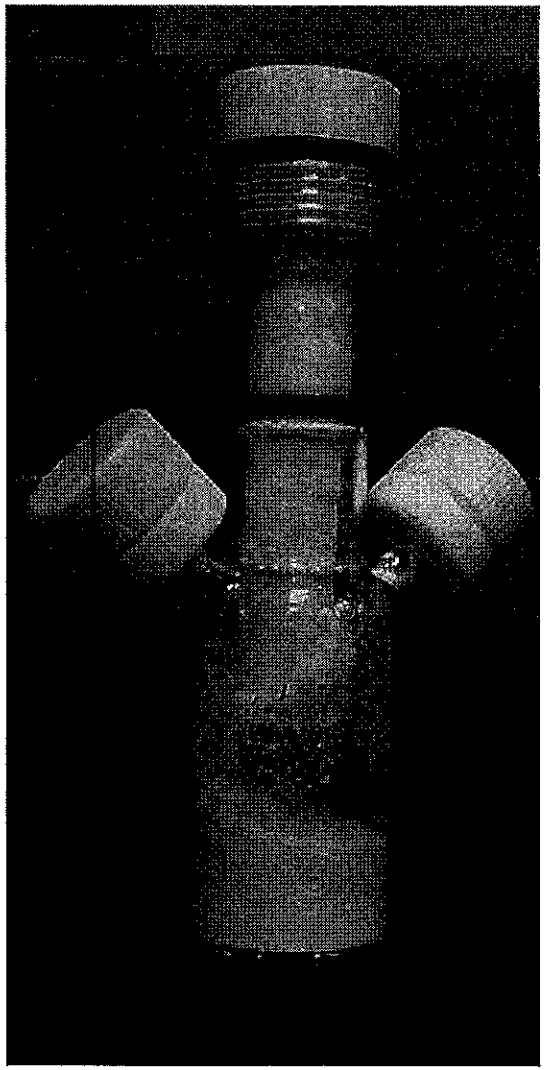
- Minimizes the loss of VOCs during quicklime addition
- Completely closed system that does not require opening when adding quicklime
- Larger volume (~100mL) than that of the EPA vials (40 mL)
- Secure caps


Quicklime loaded in the cavity of a Teflon insert
Before quicklime addition
Quicklime is added to the contaminated soil
Quicklime
Outer cap
Inner cap
Headspace
Water& soil

Before and After: Quicklime Treatment in the Laboratory Experiments

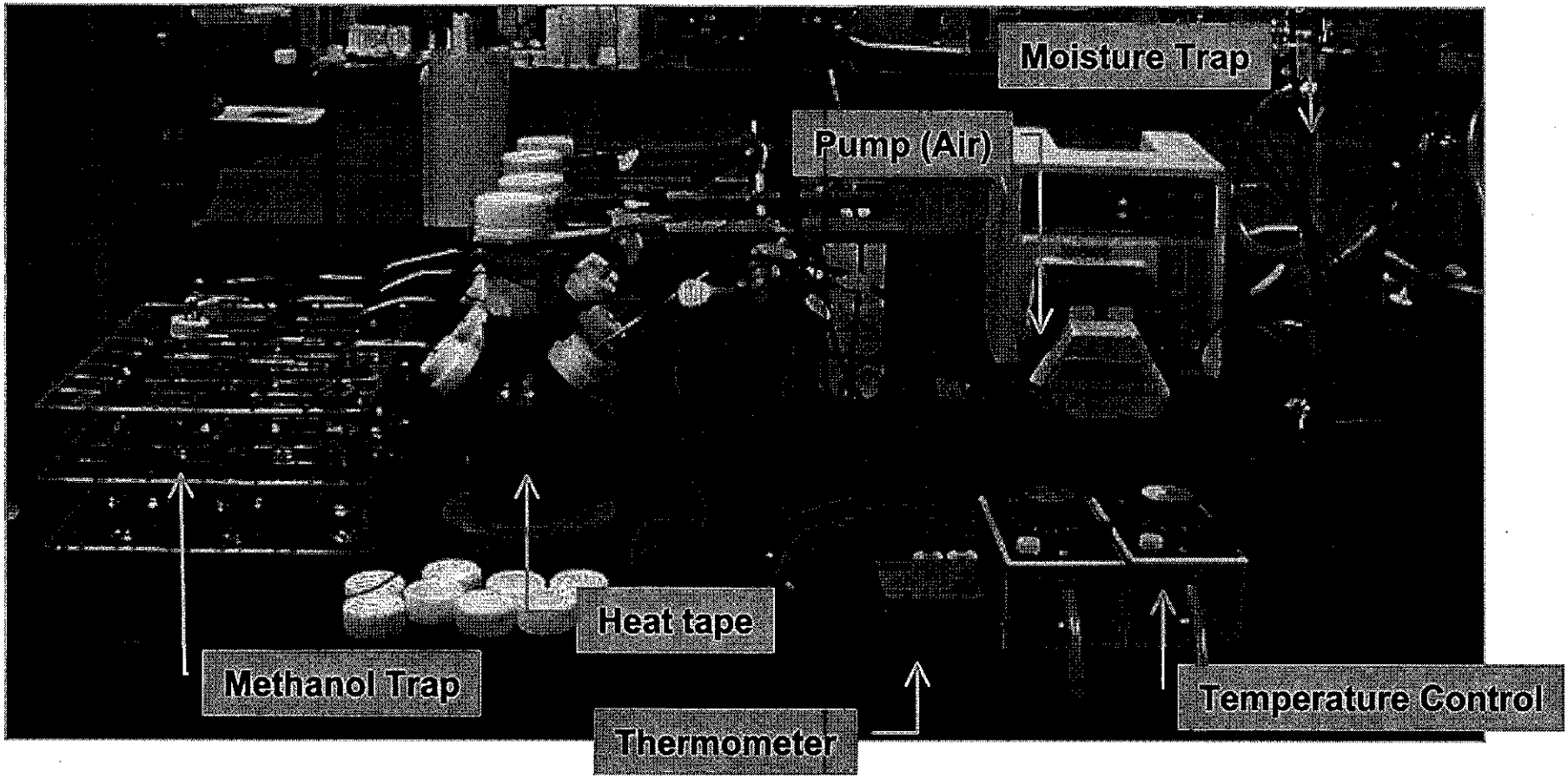


Before



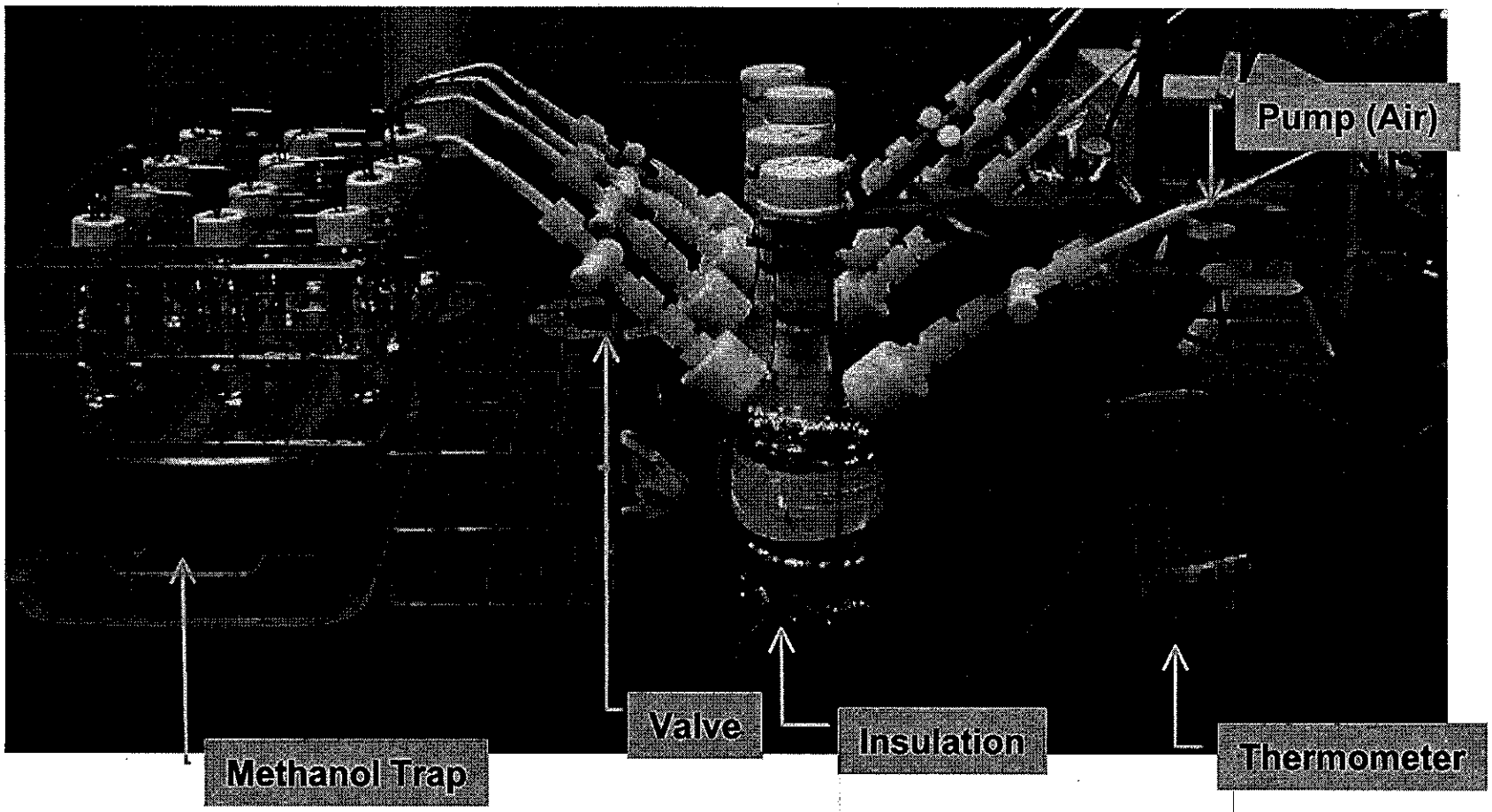
After

Extraction of VOCs from Treated Soils (Batch Tests)



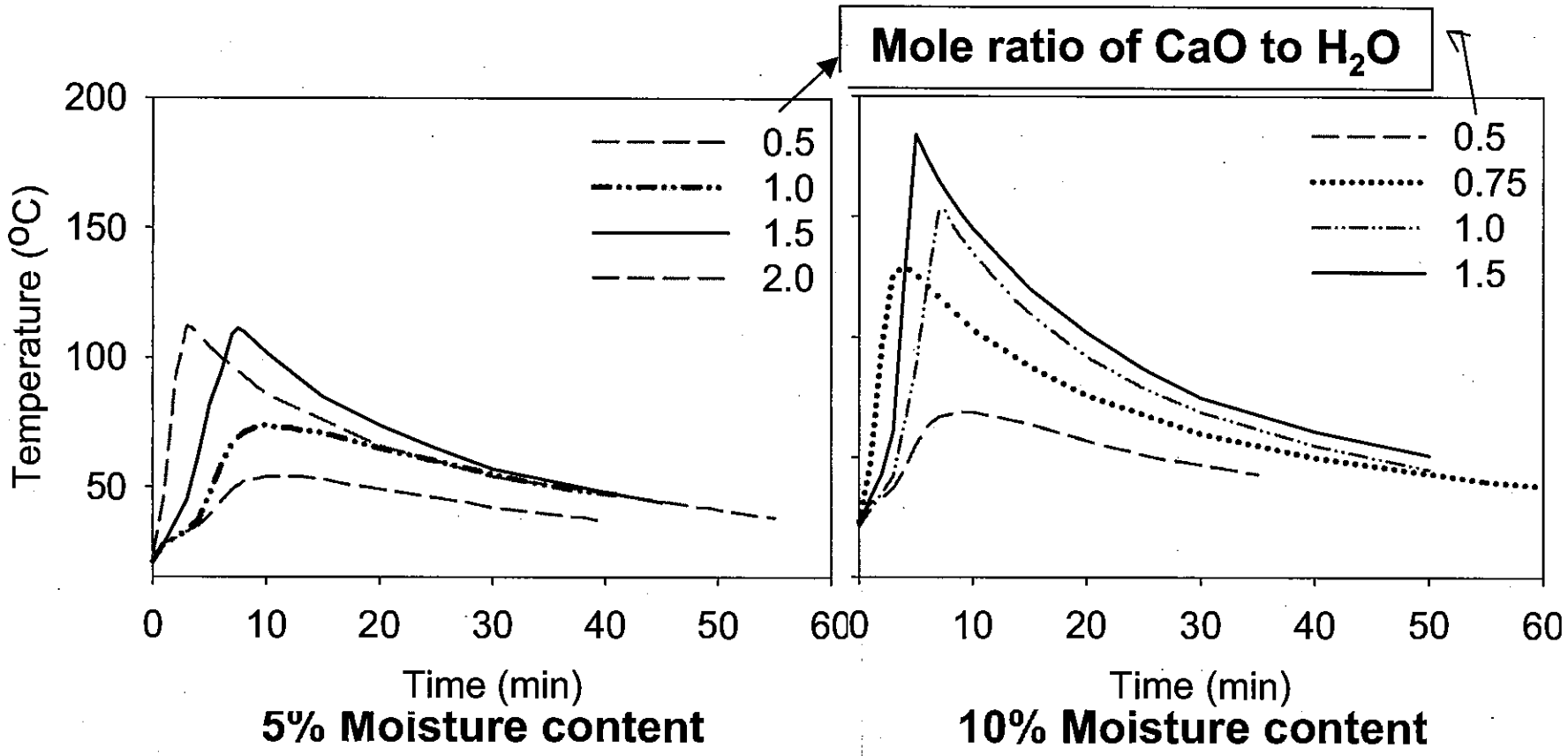
- **After the reaction is complete, air is pumped through the vessel and into three vials that contain methanol, which trap gas-phase chemicals from the headspace of the vessel.**
- **The vessels are heated after the reaction promote the evaporation of VOCs for analysis.**

Real-Time Experiments



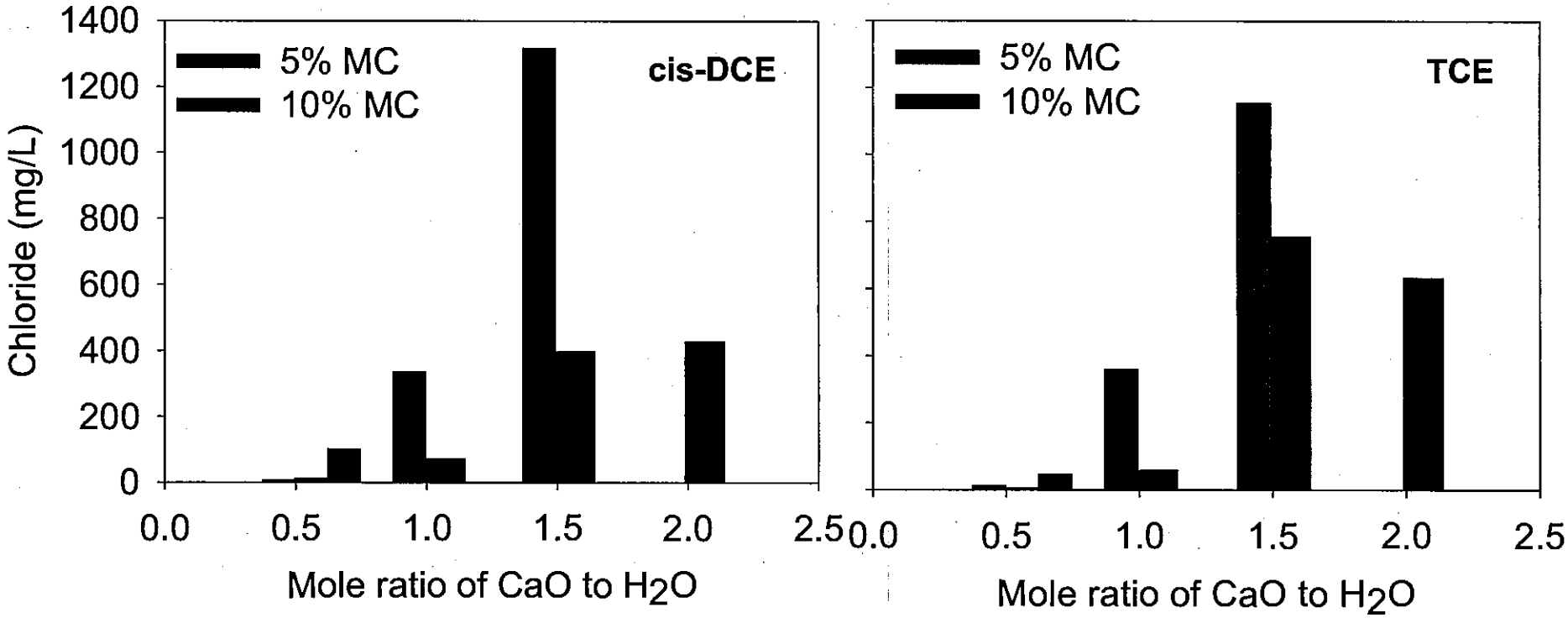
- **Air is pumped through the vessels throughout the reaction during the real-time experiments. This allows the volatilization rate to be measured.**
- **Temperatures are monitored throughout the experiments to determine the highest temperature reached during the reaction.**

Temperatures During the Reaction



- The temperatures during the reaction varied with moisture content and the amount of CaO. The temperature peaked quickly a few minutes after treatment.
- The temperatures ranged from 50°C to 184°C in the selected mole ratios of CaO to H_2O.

Amount of Chloride in the Soil After Treatment with Various Amounts of Quicklime and Water



The chloride concentration dramatically increased with higher ratios of CaO to H_2O in the 10% MC contaminated soil, but chloride concentrations in soils containing 5% MC showed relatively smaller increases.

Preliminary Conclusions

- The treatment of cis-DCE or TCE-contaminated soil with quicklime using laboratory tests has shown a decrease in the concentrations of the contaminants.
- The presence of chloride in the treated soils indicates that at least some TCE and DCE destruction is occurring.
- Chloride in the treated soil increased as the amount of quicklime and water added increased.

Preliminary Conclusions

- Regulatory Concerns:
  - The amount that is volatilized and not destroyed
  - Affect of the reaction products on the environment
- Our experiments must be able to fully account for all chemicals before and after the reaction
- One commercial product similar to quicklime has been approved by the FDEP for use, but its exact chemical composition and reaction mechanism is unknown

Future Activities

Continue batch and real-time tests:

- Refine procedure for various factors (soil properties, chemicals, and mixing properties)
- Replicate the contaminated soil from Fairbanks and use in experiments

Perform Larger-Scale Experiments

- Test the effectiveness of quicklime as a treatment of contaminated soils using a larger vessel to attempt to replicate real-world conditions
- Evaluate the application of the technology with different types of contaminated soils
- Investigate and compare results to laboratory studies

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Ex-Situ Treatment of Dense Non-Aqueous Phase Liquids Using Calcium Oxide (Quick Lime).

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19th Annual Conference on Soils, Sediments and Water

Northeast Regional Environmental Public Health Center

University of Massachusetts

Amherst, Massachusetts

October 20 – 23, 2003

ABSTRACT

Open excavation was selected to remove dense, non-aqueous phase liquids (DNAPLs) identified by previous assessment activities at the FDOT Fairbanks Disposal Pit in Gainesville, Florida. The DNAPLs resulted from the disposal of asphalt testing residue and consisted primarily of trichloroethene and 1,1,1-trichloroethane. Presumptive and visual evidence of DNAPLs had been found in three areas of the site. Excavation of all three areas was conducted and DNAPLs were observed as predicted.

The original plan called for ex-situ vacuum extraction of all contaminated soils. All potentially contaminated soils were to be processed through a rotary trommel, staged in 100 cubic yard piles, and sampled for analytical testing. Due to the increasing clay content of the deeper soils, the trommel could not be used for most of the potentially contaminated soils. Quick lime was mixed into the soils at an approximate 5% ratio to improve the soil handling characteristics. The combination of the heating and chemical reaction between the soils and the lime removed the contaminants to below the leachability soil cleanup target levels, and all contaminated soils were ultimately treated by mixing with quick lime. The soils treated with quick lime were returned to the excavation to stabilize the slopes after confirmation soil samples verified the treatment goals had been reached. Approximately 10,000 cubic yards of soil were treated with quick lime, saving several million dollars as compared to off-site disposal.

Keywords: DNAPL, calcium oxide, quick lime, ex-situ soil treatment

SITE BACKGROUND

The Fairbanks Disposal Pit (FDP) is an abandoned sand borrow pit, approximately 10 acres in size, in Fairbanks, Alachua County, Florida. The FDP is owned by the Florida Department of Environmental Protection (FDEP) and operated by the Florida Department of Transportation (FDOT). FDOT purchased the site in 1956 as a borrow source for sand and clay for road construction. Beginning in 1956, the site was used to dispose of waste and topsoil collected from roadsides, demolition debris, and construction debris. Waste generated by the FDOT's Bureau of Materials Research (BMR) Laboratory was also collected and disposed at the FDP. Disposal activities continued until 1982. No records exist to document the quantity of hazardous wastes disposed during site operations.

The wastes derived from the BMR Laboratory included chemicals used in laboratory testing. A major portion of their work is to test asphalt paving materials to determine if they meet FDOT specifications. From 1956 until approximately 1961, carbon tetrachloride was the solvent used to dissolve asphalt samples. In 1961, carbon tetrachloride was replaced by the solvent 1,1,1-trichloroethane. In 1980, the Abson recovery process began to be used to dissolve the asphalt samples. Benzene was the solvent used in this process until 1981, when trichloroethene was substituted.

Between 1956 and 1978, waste solvents were recycled after distillation in a solvent still. The still was closed in 1978 when it was identified as a fire hazard. Information regarding disposal of waste from the distillation unit could not be found. During removal

activities conducted in 1983, a total of 1,046 drums were excavated from the pit area. In addition to the initial drum removal in 1983, further excavation at the site in 1990 removed 345 drums. An additional 35 drums were removed during closure activities in 1994 and 1995. In addition to disposal of drummed wastes, liquid wastes were reportedly poured directly into trenches on site.

WRS Infrastructure & Environment, Inc. (WRS) was retained by FDOT in January 1994 to complete the physical closure activities in response to a CERCLA Administrative Order. Following soil excavation activities, WRS was tasked with designing and installing groundwater treatment systems to address groundwater contamination identified in four aquifers that underlie FDP. Groundwater treatment systems for all four aquifers were installed and started up between December 1995 and April 1996. In 1998 it was noted that the influent concentration in two surficial groundwater recovery trenches closest to the 10-acre site were not decreasing, suggesting a source of contamination was still present. A Geoprobe™ investigation was conducted in 1999 in an effort to assess possible sources contributing to the dissolved phase contaminant concentrations observed in the recovery trenches. WRS initiated direct push investigations on the modified RCRA cap, downgradient of the cap, and along the horizontal recovery trenches. Additional assessments using a membrane interface probe, a Rotasonic™ drill rig, and extensive soil sampling by the University of Waterloo were conducted in 2000. Presumptive evidence of dense, non-aqueous phase liquids (DNAPL), defined as groundwater concentrations greater than 1% of the solubility limit, was found in four areas under the northern half of the 10-acre site. Concentrations as

high as 1,200,000 µg/l of trichloroethene were detected and DNAPL was visually identified in three of these areas. The DNAPL was located on top of, and diffused into, a clay layer located approximately 35 to 40 feet below land surface.

Based on the findings of additional assessment activities, FDOT elected to proceed with physical removal of soils that were possibly acting as continuing contaminant sources. WRS's scope of work included the following proposed remediation activities:

- Removal of the clean overburden (land surface to 30 feet below land surface)
- Dewatering using horizontal dewatering trenches and sump pumps
- Excavation of potentially contaminated soils below a depth of 30 feet
- Power screening these soils using a rotary trammel to remove any debris
- Sampling and segregating clean and contaminated soils
- Ex-situ vacuum extraction of contaminated soils in an existing, lined storm water pond
- Addition of 5% calcium oxide (quick lime) as needed to improve the soil handling characteristics of clayey soils that were expected to be encountered at depth.

The goal of the remediation was to remove all soils exceeding the leachability soil cleanup target levels in Chapter 62-777, Florida Administrative Code. The target levels for the contaminants of concern were benzene (7 µg/kg), 1,1-dichloroethene (60 µg/kg), trichloroethene (30 µg/kg), and 1,1,1-trichloroethane (1,900 µg/kg).

QUICK LIME PROPERTIES

Calcium oxide (quick lime) is a white crystalline solid manufactured by heating (calcining) limestone, dolomite, coral, oyster shells, or chalk (which are all mainly calcium carbonate) to drive off carbon dioxide. More than 90% of the lime produced in the United States is used for basic or industrial chemistry. The primary uses are (Kirk-Othmer 1991a, b; Budavari, 1986):

- steel manufacture,
- metallurgy,
- air pollution control,
- water and sewage wastewater treatment,
- cement and mortar,
- chemical manufacturing,
- glass and paper manufacturing,
- sugar refining.

Calcium oxide is also used frequently in the construction industry for soil drying, soil modification, and soil stabilization. Quick lime reacts with water to produce heat (as high as 800° C) and calcium hydroxide (hydrated lime). When applied to wet soils or mud, the reaction consumes approximately 30% water by weight plus removes additional water as steam and provides dry solids for stability. The most dramatic soil modifications occur in clay soils of moderate to high plasticity. Modification occurs

because the calcium cations supplied by the lime replace the cations normally present on the surface of the clay mineral. The clay surface mineralogy is permanently altered and the clay soils and changed to silts, producing the following benefits (Little, 1999):

- Plasticity reduction
- Reduction in moisture-holding capacity (drying)
- Swell reduction
- Improved stability

Highly plastic clays can be immediately and permanently changed to low plasticity silts using quick lime. This was the reason quick lime was proposed to amend the soil handling properties of the clays expected to be found at depth at the FDP site.

From an environmental standpoint, calcium oxide is benign. The US Food and Drug Administration has affirmed that calcium oxide is generally recognized as safe as a direct human food ingredient. It may be used in food with no limitation other than current good manufacturing practice. However, working with quick lime does present some difficulties. It will react with any moisture, including sweat, eyes, and lung tissue so adequate personnel protection is essential. It is also incompatible with many organics, halogens, acids, and combustible materials.

SOIL REMEDIATION USING QUICK LIME

Excavated soil from below 32 feet at the FDP site demonstrated increasing clay content with depth. As the clay content increased, the rotary trommel became unable to effectively process the soils. As proposed in the original work plan, quick lime was added to improve the materials handling. The objective was to modify the clays into non-cohesive silts that could be processed by the trommel. Quick lime was mixed with the soils with a large road tiller to amend the soil for treatment. Approximately 5% by volume quick lime was added to the clayey soils. The reaction of the quick lime with the soil moisture generated significant amounts of heat. In addition, quick lime chemically reacts with many organics. Because the contaminants of concern were volatile organics, WRS sampled the soils after addition of the quick lime to determine the effect, if any, of the quick lime addition. Analytical testing of the soils after mixing with the quick lime demonstrated that the target levels had been achieved and that no further treatment was required. Perimeter air sampling did not detect any chlorinated solvents during the treatment process. Leaching tests were also conducted on the treated soils to determine if the quick lime was somehow masking the chlorinated solvents during the soil analyses. No contaminants were detected in the leachate samples. It was concluded that the soil remediation resulted from volatilizing the chlorinated compounds by the heat of reaction between the quick lime and water, possibly combined with a direct chemical reaction with either the halogens or the organic compounds.

The soil processing procedure was then modified by staging all potentially contaminated soils in one large pile in the processing area. Soils containing visible DNAPL were treated in the excavation by mixing in quick lime with a backhoe prior to removal. All potentially contaminated soils were placed in the lined soil treatment area in 18-inch lifts. The quick lime was delivered in 2,000 pound supersacks which have a discharge chute built into the bottom. A backhoe was used to pick up the supersacks and spread the quick lime over the soils to be treated. The quick lime was then mixed into the soils using a large road tiller. The treated soils were stockpiled and sampled. A total of 569 soil samples were sampled from the soil processing area. All soils were ultimately classified as clean although some soils required additional treatment before a clean status was achieved. Soil analytical results initially categorized as contaminated (above the leachability soil cleanup target levels), per on-site mobile laboratory results, were re-processed with quick lime. Clean soil was hauled to the clean soil stockpile. No soils exceeding the leachability standards left the processing area.

Soils from below approximately 35 feet, soils previously placed in the lined pond, and sediments from the dewatering equipment were processed in this manner. Approximately 11,500 cubic yards of contaminated soils were treated with the quick lime.

Once the planned excavation was completed, floor and wall samples were taken in the excavation to confirm that all contaminated or potentially contaminated material had been removed and that only clean, undisturbed material remained. If the confirmation soil samples indicated values exceeding the leachability levels, an additional ten foot by

ten foot area around the location was excavated an additional two feet deep. These two foot intervals continued until the confirmation samples were below leachability levels. As the excavation activities continued, it was apparent that source areas would need to be excavated much deeper than the initial 37 feet. The final excavation depth reached 49 feet below land surface in one area of the site. The excavation boundaries were also extended further west and north based on the confirmation sample results.

COST

The delivered cost of the quick lime was approximately $200 per 2,000 pound supersack. Using a 5% by volume mixture resulted in a material cost of approximately $10 per cubic yard. The multiple soil handing steps dictated by the site constraints added approximately $20 per cubic yard in handling and processing costs. The total cost to treat the contaminated soils to the leachability target levels was approximately $30 per cubic yard, or a total of $350,000 for the approximately 11,500 cubic yards of treated soils. These costs do not include the cost of clean overburden removal, dewatering, or treatment of the dewatering discharge. Compared to an off-site transportation and disposal cost of $250 to $300 per ton, a savings of $2.5 to $3 million was realized. Any potential liability from the off-site disposal was also eliminated.

CONCLUSIONS

Calcium oxide (quick lime) was used to successfully remediate 11,500 cubic yards of soils contaminated with chlorinated solvents and DNAPLs for a unit cost of approximately $30 per cubic yard. The soils were successfully treated to the leachability soil cleanup target levels in Chapter 62-777, Florida Administrative Code and to non-detectable concentrations in most cases. The treatment mechanism is most likely a combination of heat to vaporize the volatile contaminants and a direct chemical reaction with the quick lime. Further research is needed to identify the exact mechanisms. The cost savings as compared to off-site transportation and disposal was $2.5 to $3 million and any potential liability from the off-site disposal was eliminated.

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